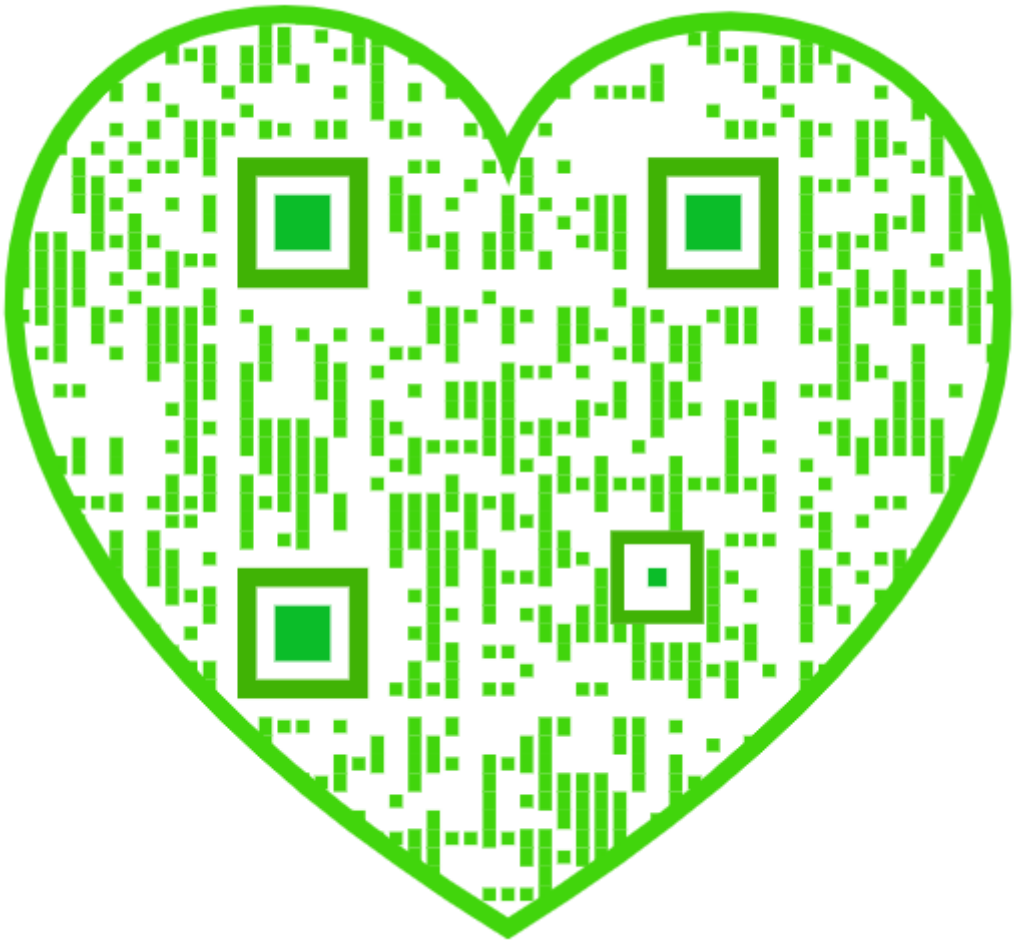
# SURGICAL OPERATIONS
WITH
# LOCAL ANAESTHESIA
BY
ARTHUR E. HERTZLER, M. D.



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# SURGICAL OPERATIONS

## WITH

# LOCAL ANESTHESIA

BY

ARTHUR E. HERTZLER, M. D.

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SURGERY PUBLISHING COMPANY
92 WILLIAM STREET
NEW YORK
1912

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## PREFACE.

The object in presenting this book to the profession is to furnish in a convenient form the technic of some of the commoner operations that can be done in a satisfactory manner under local anesthesia. I have had in mind the needs of the general practitioner and the surgeon who works without the advantages which accessibility to a hospital affords. For this reason, operations have been omitted which require considerable experience in the use of local anesthetics. With this in mind, I have deemed it best to present a record of my own methods in order to assume more consistently responsibility for the efficiency of the methods recommended.

Thanks are due Dr. E. T. Gibson who has read the proofs, to Dr. W. J. Walker who looked over the manuscript, to Dr. Ford B. Rogers who collated the literature, and to Tom Jones who prepared the drawings.

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# CHAPTER I

## General Considerations

That so many agents have been used to produce local anesthesia is evidence, in the first place, of the value of the method, and, in the second place, of the fact that the ideal local anesthetic has not yet been found. It has appeared from statistics that general anesthesia is attended by minimal danger; yet recent knowledge of the late effects of chloroform causes us to inquire if ether, too, may not give rise to delayed deleterious effects which have hitherto been unsuspected. One death in 15,000, which is now accepted as the fatality rate of ether, may not express the real mortality if remote effects are considered. This is not the place to inquire into the dangers of inhalation anesthesia, but I am convinced that if operators should interrogate their knowledge of fatalities after the use of ether in their own practice or in that of their friends, faith in the accuracy of the statistics above quoted would be much shaken. Every surgeon knows of instances in which death occurs after the patient is returned to bed from causes not perfectly clear, following operations in themselves not dangerous, but during which the patient was blue, because of an incompetent or careless anesthetizer or from unavoidable causes. If in addition to this the surgeon notes the results in a large series of operations under local anesthesia, in which no such unpleasant experiences arise, he becomes convinced that ether is not the innocent agent statistics would seem to show. That this conviction is wide-spread is attested by the eagerness with which the profession regards the promise of any

Value of Local Anesthesia

method leading to the abandonment of general anesthesia. Those who have employed local anesthesia for major operations upon patients reduced by disease have been convinced that under certain conditions at least, general narcosis directly jeopardizes the life of the patient by lessening his resistance to the disease, in ways, too, perhaps at present unsuspected. This applies particularly to a large number of palliative operations which will be considered *seriatim* in another place.

## Indications

The indications for local anesthesia may be arranged under several heads.

1. These are such procedures as the removal of foreign bodies, the excision of small tumors, the incision of superficial abscesses, etc., in which even in large hospitals the use of local anesthesia is resorted to because it entails the least labor, or because it is clearly unjustifiable to subject the patient to the unpleasant experience of a general anesthetic. In private practice the regard for the convenience of the patient is sufficient indication for its use.

**Trivial Operations**

2. Local anesthesia finds its largest field no doubt outside of hospitals, where little or no skilled help is available. Operations under such conditions are often emergencies, as strangulated hernia, tracheotomy or thoracentesis and a large variety of abscesses which demand immediate relief. Often the nature of these diseases presents a contra-indication to general anesthesia. Often, too, the practitioner is confronted by surgical diseases of such a character as to permit the patient to be cared for at his home so that a sojourn at a hospital would be needless expense. It is for these cases that local anesthesia

**Operations Demanding Local Anesthesia**

is particularly adapted, for it is in these conditions that the practitioner is forced to operate without general anesthesia or not at all. This includes operations which an increasingly large number of general practitioners are capable of doing, who are, however, without hospital facilities and frequently without assistants. Among them are such operations as the removal of benign tumors, and operations about the extremities, the scrotum and the anus. The large majority of these operations go by default, the patient preferring to bear his ills rather than seek a hospital for relief.

3. Quite apart from the dangers is the unpleasantness of inhalation narcosis. The fear of the anesthetic is not dependent upon ignorance of its safety. Everyone knows of medical men who submit to the inconvenience of certain diseases, such as hemorrhoids or hernias, rather than take a general anesthetic for their cure. I have been interested to note the regularity with which physicians express a preference for local anesthesia when they themselves are forced to submit to operations, particularly if they have seen it successfully employed upon their patients. If medical men familiar with the safety of general anesthesia hesitate to accept its risks and unpleasantness we cannot refuse to listen to the wishes of the layman when he, too, seeks to avoid general anesthesia. Many patients seek the services of the charlatan for the treatment of such diseases as hemorrhoids and hernia because a cure is promised them without the use of general anesthesia. If the general surgeon were more willing to consider the patient's viewpoint, fewer would seek incompetent treatment. If suitable treatment were offered him at home under local anesthesia, the number

**To Escape Unpleasantness of General Anesthesia**

straying away from ethical practitioners would be much reduced. Problems of this sort demand a conference between the patient and operator. The decision often will depend upon the patient's nervous equilibrium and the surgeon's skill in the use of local anesthetics quite as much as upon the nature of the operation.

Choice in Certain Major Operations

4. Some surgeons have employed local anesthesia for a great variety of operations in which the majority of operators employ general anesthesia. Reclus, Halsted, Schleich, Matas, Cushing, Bodine and many others, the mere mention of whose names precludes the thought that the success of the operations under local anesthesia is otherwise than as represented, have done a large number of such operations under local anesthesia. The use of local anesthetics in this group of conditions we desire particularly to emphasize, because it does away with the chief danger attending the operation—narcosis. It includes conditions of magnitude which are usually treated where there is no lack of facilities, conditions which demand more or less experience on the part of the operator and in which the whims or fears of the patient concerning general anesthesia do not enter, and in which also, there is no obvious direct contra-indication to general anesthesia. In this list, may be placed the removal of nearly all the extra-abdominal benign tumors, nearly all herniotomies, all operations about the scrotum and anus, many operations upon the extremities, etc. The reason for preference of local anesthesia is the safety of the patient and the convenience. The convenience to the nursing staff of the hospital is great, there being no need of skillful attendance upon the patient while he is coming out from under the anesthetic.

The same advantage applies also when operations are done in private homes.

When General Anesthesia is Contraindicated

5. In this class of operations, the surgeon is in duty bound to spare the patient the additional burdens of a general anesthetic. Here may be placed the operations of the preceding groups when some condition makes the use of a general anesthetic particularly dangerous. To this may be added exploratory operations for malignant disease where the probability is that the condition is too far advanced for radical operation; palliative operations for malignant disease (gastrostomy, gastro-enterostomy, colostomy, etc.) ; resection of ribs in empyema where the heart action or respiration is embarrassed; the drainage of abdominal or other abscesses when the patient is septic. Cystotomies for prostatic obstruction may be added to this list.

REASONS WHY LOCAL ANESTHESIA IS NOT MORE GENERALLY EMPLOYED.—The question forces itself for answer: if it possess the advantages above quoted, why is not local anesthesia more generally employed? Failure to recognize the advantages of local anesthesia is not the cause; many surgeons have tried local anesthesia, only to abandon it. That the technic must be learned is the real reason. An operator experienced in operating under general anesthesia may for that very reason fare badly with local anesthesia. Being accustomed to rapid operating without regard to painful regions he chafes under the definite restrictions drawn by local anesthesia. There can be no doubt that a more accurate conception of the finer steps of the operation is required when operating under local than when operating under general anesthesia. The anatomy of the part must be more minutely considered and

the manipulations must be more gentle. The method of local anesthesia has not been studied in the necessary detail. Many technical points must be observed if a satisfactory result is to be obtained. Improper instruments and the failure to observe certain fundamental rules have, next to the lack of a technic suitable to this form of anesthesia, been the chief causes of failure in its use. When the technic of local anesthesia is studied as closely as that of general anesthesia, disappointments in its use will become fewer.

Lack of Proper Instruments

On the other hand, the improper use of a local anesthetic may invite sepsis in reduced patients, or it may encourage those untrained in technic to undertake complicated operations because of the general notion that what can be done under local anesthesia belongs to so-called minor surgery. Again, the use of local anesthesia may lead to incomplete operations either because the operator has overestimated his ability to employ local anesthesia or he has underestimated the magnitude of the operation. In nervous and irritable patients an imperfect local anesthesia may cause greater shock than a carefully given general anesthetic. This point cannot be too strongly emphasized. Patients much weakened by disease, particularly by septic processes, bear pain badly and are poor subjects for local anesthesia. Inflamed or cicatricial tissues make effective local anesthesia particularly difficult.

Contraindications to Local Anesthesia

Advocates of local anesthesia have been wont to emphasize its advantages unduly to the ultimate detriment of the method. Each case must be decided for itself. The skill of the operator in the use of local anesthesia, the exact condition of the patient and the character of the skill available for a general

Choice of Method of Anesthesia

anesthetic must all be weighed when operations of magnitude are under consideration. The question at issue is not what operations can be done under local anesthesia, but what operations can thus be done with best advantage to the patient. The patient and not the method of anesthesia is the object of our solicitude. Failure due to disregard of these points has caused many surgeons to abandon local anesthetics after a perfunctory attempt at their use. The various phases of pain, the peculiarities of the tissue and the general conditions present all contribute to make the problem a complex one. The anesthetologist of the future must be vastly more broadly equipped than is the professional anesthetist of the present. Until such a broad knowledge is common the argument pro and con between local and general anesthesia will continue instead of a judicious selection being exercised in each case.

## CHAPTER II

### General Principles of Local Anesthesia

Failure in local anesthesia is usually due to the fact that the operator has not provided himself with proper equipment or has not kept it in good working condition. A dull knife adds to the difficulties of the operation by requiring pressure, and nervous patients do not distinguish between sensations of pressure and pain. Dull or rusty needles, forceps that lock badly, scissors that pinch but do not cut, all tend to make a painless operation impossible.

**Selection of the Syringe**

APPARATUS.—A well working syringe and good needles are the prime requisites for satisfactory local anesthesia. The kind and size of the syringe should correspond to the use to which it is to be put. An ordinary hypodermic answers very well for small operations and may be used for nearly any operation. All-glass syringes have the advantage that the contents may at all times be seen. They bear boiling and with care are always ready for use. They must be carefully dried inside and out after use or the piston may stick fast. All-metal syringes bear boiling, but a lubricant is required to make them work properly. If not lubricated they must be dried after use and are then as troublesome as the all-glass instruments. Syringes with leather pistons are unsuited since they do not bear boiling. They may be sterilized with chemicals if they must be used in an emergency.

The piston must work smoothly within the barrel or pressure causes unequal expulsion of fluid

through the needle which causes pain to the patient by the sudden dilatation of the tissues. The most common fault is that the calibre of the barrel differs in different portions. Such instruments work with difficulty in the narrow portions of the tube while the wider portions permit the fluid to leak past the piston. Nothing seems to take operators longer to learn than that the fluid which escapes past the piston and runs down the wrist does not contribute to insensitization of the field of operation. Nearly all of my operations have been done with an ordinary 25 mm. syringe (Fig. 1), but it is convenient to have

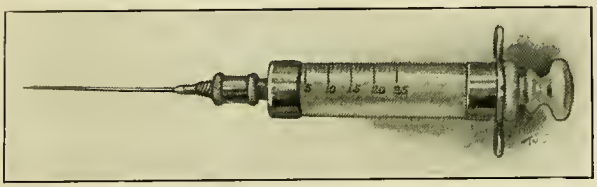


Fig. 1. Metal mounted syringe with glass barrel and piston.

instruments adapted to special purposes. For operations requiring a large amount of fluid a syringe of greater capacity saves the necessity of frequent refilling. The greater the diameter of the barrel the greater the pressure required to force the fluid out of the needle. For this reason the large syringes can be used only in loose tissue. Their use, therefore, is confined to the edematization of areolar or muscular tissue. In operations upon the tonsil or cervix, an extension (Fig. 2) makes the site of injection much more accessible. For dental work a more powerful instrument (Fig. 3) is desirable because of the density of the tissue to be injected.

For this purpose all-metal syringes are preferable; for the glass barrel will not withstand the high pressure required for the infiltration of the dense tissues.

Needles

Not less important than the syringe is the needle. Unless the needle is sharp and free from rust, need-

Fig. 2. All-metal syringe with extension for use in throat and pelvic operations. The extension may be used on the glass metal-mounted syringe (Fig. 1).

less pain will be caused when it enters the skin. By carefully drying it after use its usefulness may be much prolonged. The length of the needle must

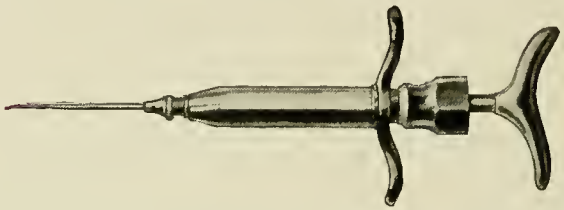


Fig. 3. All-metal dental syringe. The piston is small in diameter and the handle powerful permitting of high pressure within the tissues.

correspond to the requirements of the case. Often the structures to be operated are much deeper than they appear. As a consequence, the surgeon uses too short a needle and fails to reach the deeper parts. The ordinary hypodermic needle is sufficient in a large number of operations, but in many which involve the deeper structures it is inadequate. Long

needles are required particularly for removal of the larger tumors and in operations about the anus. The use of too short a needle is a common cause of failure. The operator is very apt to underestimate the distance of the sensitive area from the surface, particularly in corpulent persons. Special needles are often convenient for particular requirements, as for instance the angular needle used in dentistry. The curved needle used by many European operators is convenient for many purposes, particularly for injection about small tumors; but the inconvenience in caring for them quite outweighs this slight advantage.

**Exact Diagnosis Essential**

SELECTION OF THE PATIENT.—Before local anesthesia is decided upon, an exact anatomic diagnosis of the disease is the first essential. The anatomic relations of every manipulation must be distinctly seen in the mind's eye of the operator before he decides to use local anesthesia. Unless he is thus able to see clearly the various steps of the operation he cannot determine the exact requirements of anesthetization. The disease in its pathological relations likewise must be clearly noted. Inflammation, because of the changes in the body fluid in the region to be attacked, makes local anesthesia difficult. Lesions which are the site of abundant scar formation likewise present difficulties because of the poor diffusibility of fluids in such tissues.

**Mental Attitude of the Patient**

The patient must be considered. Apprehensive patients and those unaccustomed to the exercise of the will or unaccustomed to subjecting themselves to the authority of others make bad subjects for local anesthesia. Worst of all are those who make the most of the joys of suffering; who are disposed to magnify suffering because of its dramatic rela-

tions. Such patients writhe and groan from a simple hypodermic injection. They belong wholly to that class of patients in which the indications for local anesthesia are but relative; weighing the inconveniences of patient and surgeon will cause the experienced to avoid local anesthesia. The demeanor and personality of the surgeon is often able, however, to transform such patients into sensible subjects for local anesthesia.

GENERAL PREPARATION OF PATIENT.—It is desirable that a patient about to undergo an operation should be in the best possible physical condition and that his mental equilibrium should be undisturbed. Unless some special indication exists no great departure from normal living is required. A full bath, normal bowel movement and a restful night's sleep are helpful to both patient and surgeon. A patient about to be confined to bed for a period of days should make his dietary harmonize with the enforced inactivity. When local anesthesia is to be employed purgation and starvation particularly are to be avoided because they tend to excite the apprehension and disturb the equilibrium of the patient.

Physical Well-being and Mental Tranquility Needed

SPECIAL PREPARATION.—After the full bath, if the operation is a major one, the region is washed and shaved. Immediately before the operation the field is painted with Tr. Iodine either full strength or diluted with an equal quantity of alcohol. In operations about the scrotum or anus this cannot be employed; here soap and water must be depended upon. The use of iodine has proven reliable and where the nature of the skin permits its use is more pleasant to the patient than the vigorous scrubbing with soap and water. The use of soap is undesirable because it makes the skin slippery, rendering the

Clean Skin and Iodine

necessary manipulation in skin infiltration more difficult. Simple cleansing with clear water lessens this inconvenience but does not entirely remove it. Where alcohol can be employed the soap may be entirely removed by this means. About the labia and scrotum neither iodine nor alcohol can be employed because of the irritation produced; simple rinsing must be depended upon.

The preparation of the instruments and accessories is of course the same as when general anesthesia is employed. The syringe should be sterilized with the instruments. The receptacle in which the solution is made should also be boiled. Ordinarily 1 oz. medicine glasses are of a convenient size and are sufficiently accurate for the purpose.

THE PRELIMINARY HYPNOTIC.—If the patient is restless and expresses fear of his ability to withstand the operation, or if the operation is to be one of magnitude, a preliminary dose of morphine may be given. This I have called "removing the hypertension from the apprehension." The initial dose of morphine likewise lessens the pain produced by tugging on parts not anesthetized. This applies particularly to abdominal operations. The morphine should be given a half hour or an hour before the time of operation.

Morphine to Allay Apprehension

If the morphine cannot be given at least half an hour before the operation is to begin it should be omitted entirely, for in the first minutes after its administration it excites rather than quiets the patient. The dose need not be large; $^1/_6$ to $^1/_4$ grain is sufficient. In operations about the anus or rectum the usual addition of atropine should be avoided since it tends to produce retention of urine. In other regions there is no objection to its use. Hyos-

cine, because of the uncertainty of its action upon the mental state of the patient, should not be used. The beginner will do well to use the initial dose of morphine in all major operations. The expert will often omit it. If a contra-indication to morphine exists it should not be used. The most common contra-indication to the initial dose of morphine is an advanced nephritis.

## CHAPTER III

### Technic of Administration

Tranquillity of Environment Essential

In carrying out operations under local anesthesia the most important factor is confidence on the part of the operator that the results will be satisfactory. If the operator is apprehensive the patient is sure to imbibe his lack of confidence. Every movement must bespeak confidence and tranquility.

When the injection of the anesthetic solution is to begin the patient should be instructed to assume a comfortable position upon the operating table and he may be allowed to witness the preparation of the instruments in order that he may become familiar with the sound of their manipulation. The conversation had better be concerned with the relative merits of popular baseball pitchers than with the immortality of the soul. In other words, the patient should be made to feel that the operator is alert and seriously minded but not worried or apprehensive. The advantage of a mutual confidence in the success of the operation is incalculable, and the operator should spare no pains in mastering the confidence of the patient. If the operation is such that the necessary steps can be carried out while sitting this position may be assumed by the operator, since it is less fatiguing and usually permits more delicate and accurate manipulations.

Importance of a Good Start

Before the initial injection the patient should be told that the first prick of the needle will cause about as much pain as the giving of an ordinary hypodermic injection. One of my patients estimated the

pain as about "two mosquito power." I have used this expression with advantage to the mental poise and comfort of the patient. This forewarning prepares him for the slight pain. It is remarkable how far this little detail goes toward gaining the confidence of the patient and establishing his faith in the success of the procedure.

Various methods are employed depending upon the character of the tissue to be operated upon and the topographic relations of the nerves.

Endermic Method

1. If the skin alone is to be incised the fluid may be injected directly into the papillary layer. This may be called *endermic* anesthetization.

Subdermic Method

2. The nerves may be anesthetized by bringing the fluid in contact with them before they enter the skin. The fluid is deposited in the subcutaneous areolar tissue. This is *subdermic* anesthetization. These methods are employed for anesthetization of the skin. The latter is also employed for anesthetization of fascia and periosteum.

Edematization

3. When large areas of slight or indefinite nerve supply are to be anesthetized large quantities of weak solution are injected into the tissue so as to produce a veritable edema. This is appropriately called anesthetization by edematization.

Nerve Blocking

4. The ideal method is to anesthetize the nerve trunk in continuity. This is accomplished by injecting a quantity of the fluid into the substance of the nerve making the entire area supplied by the nerve insensitive. This method can be employed only where a nerve of sufficient size supplies the region to be operated upon. This method is called nerve blocking.

5. In some instances when the nerves are too small to be individually injected they may be an-

esthetized by injecting fluid in their immediate vicinity which inhibits the transmission of impulses. This method may be called perineural blocking.

Perineural Blocking

ENDERMIC INJECTION.—This method seeks to anesthetize the end organs in the skin. Anesthesia is dependent in part on pressure within the tissues, but the chief action is a direct chemical effect upon the nerve endings. With quinine and the stronger cocain solutions this is, no doubt, the case, but pressure adds to the effect. The fluid should, therefore, be

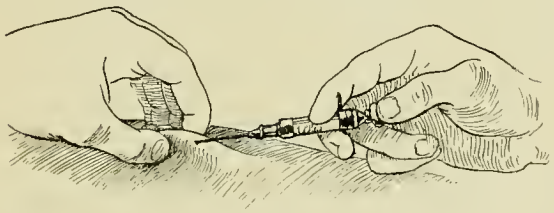


Fig. 4. The skin is pinched between the fingers for the initial injection.

brought as nearly as possible in direct contact with the nerve endings, that is, in the papillary layer of the derma.

In beginning the injection, the skin is picked up between the thumb and forefinger of the left hand and firm pressure is made until it is quite blanched (Fig. 4). In this way it is made less sensitive to the initial prick of the needle. As soon as the point of the needle has entered the epidermis, slight pressure on the piston forces out the solution which, displacing the blood in the capillaries, causes a blanching of the skin. The injection is made intradermically so that the fluid as it escapes from the needle comes in contact with the nerve endings in the papillary layer of the skin (Fig. 5). If the

The Initial Injection

needle passes deeper than this the fluid escapes into the loose subcutaneous cellular tissue and an edema is produced, but the skin is unchanged in color.

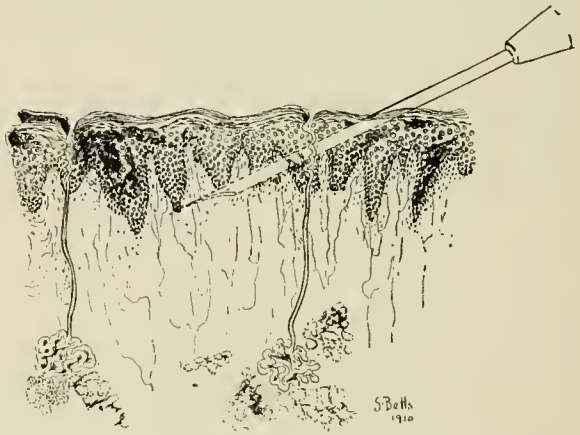


Fig. 5. Injection about the nerve endings in the papillary layer.

With the appearance of the blanching anesthesia has already taken place in the area thus affected. The needle should now be pushed forward to near

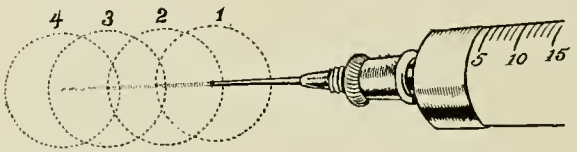



Fig. 6. Method of advancing needle through successive blanched areas without withdrawing it.

the opposite border of the blanched area and the piston again pressed. A blanched area is produced extending for a distance in advance of the needle (Fig. 6). When the needle will no longer reach

far enough, it is withdrawn and introduced again near the edge of the blanched area and the injection proceeds as before, until the entire line of the proposed incision has been injected. As soon as the injection is finished the incision is made. Care should be taken to note the line of infiltration, for if properly done, the blanching has disappeared before the infiltration has all been made. The proposed line of injection may be marked by drawing tincture of iodine along it, provided this drug has not been used to sterilize the field of operation. This serves as a guide to the amount of anesthetized tissue when the sutures are placed. All skin and mucous surfaces may be anesthetized in this way. The advantage of this method is that it requires a minimum amount of fluid and the anesthesia is complete as soon as the infiltration is complete. The surgeon's skill in the use of local anesthesia is better shown in this part of the operation than in any other. The needle passed just within the skin is followed promptly by the expression of a drop of fluid. The unskilled are apt to express a large amount of fluid which produces a burning pain due to the distension of the tissue. This pain is of momentary duration to be sure, but it is often sufficient to shake the patient's faith in the efficiency of the method. Each time the needle is advanced to the edge of the infiltrated area the same gentle pressure upon the piston must be exerted. If the injection is properly done the initial prick alone causes pain. The width of the line to be infiltrated may be varied by the amount of fluid injected; the more fluid is forced out at each point the wider will be the area infiltrated by the fluid.

**Gentleness the Measure of Skill**

After the injection is completed and before the incision is made a test of the sensitiveness of the

Test for Sensitiveness Before Beginning Incision

area should be made by pricking the skin with the needle of the syringe or the point of the knife in order to determine if the anesthesia is satisfactory. This precaution applies to all regions and all methods. An error commonly made is to extend the incision beyond the infiltrated area. The incision within the line infiltrated progresses painlessly until the unanesthetized skin is reached. The patient is startled by the sudden pain which, combined with

Fig. 7. Subdermic injection. The fluid enters the subdermic connective tissue producing an elevation.

the surprise of the operator, may shake the confidence of the patient and mar the success of the operation.

SUBDERMIC INJECTION.—In this method the injection is made beneath the skin in the loose connective tissue (Fig. 7). It may be used for the anesthetization of skin or mucous membrane. It is used as a substitute for endermic injection when the skin is very thin, as in circumcision, or in mucous membranes. In such regions the tissue is too thin to be infiltrated directly and in consequence the nerves must be reached before they enter it. This applies

also to fascia, periosteum and peritoneum. This method requires more fluid and a greater length of time because the fluid must traverse the sheath of the nerve filaments before anesthesia is complete. It is properly employed when injection about a tumor is desired in order to loosen the tumor capsule. More fluid is needed than in the endermic method. It is a hit-or-miss method and should be employed only when more exact methods cannot be employed.

Some Minutes Required Before Anesthesia Appears

EDEMATIZATION.—(Schleich's method.) The distension of the tissues with fluid was introduced by Schleich in order to secure anesthesia from solutions of cocain too weak to act by infiltration. The weak solutions were used because stronger ones were dangerous. The method is, therefore, a makeshift to overcome the dangers of the drug employed. It is used almost exclusively with cocain solutions and is described in connection with that drug. The method is properly used only in loose tissue with few nerves; in regions particularly sensitive or where larger nerve trunks are involved it is insufficient. With increased experience and the use of safer drugs the method has gone pretty generally out of use; but it is still useful where tissues are to be dissected as in the ligation of vessels or in the search for nerve trunks for the purpose of nerve blocking. The edema makes the separation of the tissues easier. Where tissues are to be accurately united again, as in the operation for hernia, the method is objectionable since it interferes with the coaptation of the wound edges, though most of the fluid escapes when the incision is made. The method is particularly useful to the novice and may be used for many purposes in the absence of a finished technic. Quinine

Method of Compromise

is seldom used by this method since solutions of sufficient strength can be used to produce anesthesia by infiltration.

NERVE BLOCKING.—Some operative fields are supplied by terminal nerve trunks. These regions may be effectually anesthetized by injection made directly into the nerve sheath. In this method, it is necessary to isolate the nerve trunk and to fix it carefully with the tissue forceps before attempting to thrust the

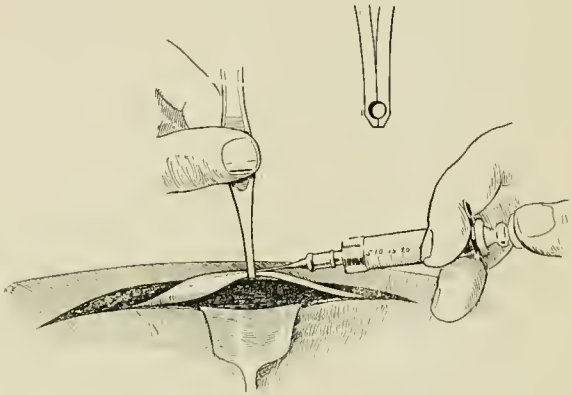


Fig. 8. Method of nerve blocking by use of special forceps.

needle into it. The forceps here illustrated (Fig. 8a) pick up the nerve with the greatest gentleness. By grasping the nerve in the hollow portion of the forceps (Fig. 8b), and by passing the needle within the grasp the forceps form a constriction about the needle; the fluid injected distends the nerve sheath sausage-like and may be made to traverse some inches up the sheath. This done, the area supplied by the nerve may be operated upon without fear of producing pain. This is the ideal method of anesthetization when the trunk of the nerve supplying

Ideal Method for Local Anesthesia

the entire region to be operated upon is accessible. It is the method employed in major operations upon the extremities and, combined with skin infiltration, it constitutes the method introduced by Cushing for inguinal herniotomy.

PERINEURAL BLOCKING.—This method is a modification of the preceding. In regions where nerves too fine for identification traverse a relatively restricted space the bundles containing nerves and other tissue may be localized with a degree of certainty. In this manner the area supplied by these small nerves may be effectually anesthetized, when the identification of the individual twigs cannot be made. This method is employed in the anesthetization of the spermatic cord and in operations on the fingers and toes. Inasmuch as the anesthetic must reach the nerve trunks by diffusion some minutes are required for anesthesia to become established.

Time Required for Anesthesia

INTRAVENOUS ANESTHESIA (Bier).—Bier's method consists in the isolation of the veins of a region by means of rubber constriction bands and the injection within the lumen of the vein of an ounce of the anesthetic solution. The fluid is diffused in the tissue and after some minutes an anesthesia of the region distal to the place of injection is obtained.

## CHAPTER IV

### Drugs Employed

In my own work quinine and urea hydrochloride is now used almost exclusively. Novocain and cocain are still used for special purposes. Inasmuch as cocain was the first drug employed for local anesthesia, it will be discussed first.

Most Efficient and Most Dangerous of All Local Anesthetics

COCAIN.—This drug has been used more than any other substance for the production of local anesthesia. The cause of this popularity is its efficiency and because of this it has continued in use notwithstanding its positive dangers. The number of fatalities has become greatly reduced since weaker solutions are used. On the other hand, the fear of its toxic effects has deterred many from using it at all and many others are satisfied with partial results rather than push it to obtain complete anesthesia. It has the property of inhibiting the transmission of painful impulses when it comes in contact with nerve endings or with the shaft of the nerve. Because of its poisonous properties cocain can be used locally only, either by topical application to surfaces capable of absorbing it or by injection about or into the nerve sheaths.

EXTERNAL APPLICATION.—All mucous surfaces may be anesthetized by the local use of cocain. In operations about the eye and nose this means of anesthesia is almost universally employed. Because of the relatively small amount required in these regions cocain is safe. About the genito-urinary organs and rectum, because of the

large surface requiring larger amounts of the solution, its dangers have been much more apparent and few operators at the present time care to risk them, preferring rather to accept the inconvenience of general anesthesia.

STRENGTH OF SOLUTION.—For local applications, particularly about the eye and nose, a 4 per-cent. solution is most frequently used. In the nose a solution of half that strength gives a very satisfactory anesthesia, particularly when combined with adrenalin, and is preferable since the stronger solution may give rise to alarming symptoms. In the eye, stronger solutions, up to 10 percent., are sometimes employed and because of the small amount absorbed they are relatively safe; but they are probably unnecessary since the weaker solution gives perfect anesthesia if properly used.

METHODS OF USE.—The thorough application of a weak solution known to be safe, usually gives a better result than stronger ones used timidly because of anticipated danger. With either weak or strong solutions, all surfaces to be anesthetized must be touched and time must be allowed for absorption to take place. The conjunctiva is effectually anesthetized by dropping the solution into the eye with a medicine dropper. Care must be taken that it is allowed to come in contact with the entire surface to be operated upon. In local operations, as in the removal of a tumor, it may be advantageous to apply the solution to the region of the prospective site of operation with a pledget of cotton. From five to twenty minutes are required to secure complete anesthesia. In the nose the anesthetic may be introduced by means of a spray or with a pledget of cotton. The former is

**Time the Important Element**

the more convenient method inasmuch as all regions of the nose can be easily and quickly reached. For intensive action, however, it is best to apply the solution to the point of prospective attack with a pledget of cotton. By this means the drug is allowed to act until the desired degree of anesthesia is obtained. When a local anesthetic is applied to a mucous surface it must be remembered that a secretion may be excited which tends to dilute the fluid used or the mucus may form a viscid coating over the cotton, preventing a further diffusion of the anesthetic. For this reason the cotton pledget should be frequently changed. The spray gives sufficient anesthesia for those parts not directly attacked in the operation and is useful in inhibiting the irritability of the mucosa should it be touched accidentally or incidentally during the course of the operation. It is usually desirable, therefore, in extensive operations, to combine these methods.

**Surface Anesthetized Must Be Free from Mucus**

It is hardly possible for enough of the chemical to be absorbed from the eye to give constitutional symptoms. In the case of the nose, however, constitutional symptoms have been produced. With the weaker solution above mentioned there is little danger of constitutional effects, particularly if an excess of the fluid is not used. In the use of the spray only enough to moisten the mucous membrane of the nose should be used. If the spray continues until the fluid runs into the mouth the danger of absorption is greater without a corresponding increase in efficiency. In applying the stronger solution by means of a cotton pledget the excess of fluid should be pressed out in order to avoid its escape into the mouth. The pledget, too, should be no larger than is necessary to cover the field of oper-

ation. With the very strong solutions (10 to 20 percent.) recommended by some rhinologists for special purposes, constitutional effects of an alarming character may be produced. These strong solutions should be used only in individuals in whom, from previous use of weaker solutions, it is known that no idiosyncrasy exists.

BY INJECTION.—Because of the slow rate of absorption from surfaces other than mucous membranes it is necessary to inject the anesthetic beneath the surface in order to bring it into contact with the nerve endings.

STRENGTH OF SOLUTION.—When cocain was first employed as a local anesthetic, 4 or 5 percent. or even 10 percent. solutions were commonly employed and a number of fatalities resulted. These high percentages are no longer used. One percent. accomplishes quite as efficient an anesthesia with proportionately less danger. It is to the credit of Schleich to have worked out a plan whereby very much weaker solutions could be used. He employed solutions as weak as 1:1000. In order to enhance the anesthetic effect of the cocain he combined it with morphine in small amounts and sodium chloride in 0.2 percent. solution. In a series of experiments he determined that these substances within themselves gave a fair degree of anesthesia if used in large amounts. This, however, was safe because of the small amount of the cocain in the solution. By using these large quantities of fluid an artificial edema is produced in which the pressure upon the nerves and their endings aids very materially in the production of the anesthesia. The following formulas are those recommended by Schleich:

Schleich's Solutions

1. Cocain Hydrochlorat ..... 0.2 3 gr.
   Morphine " ..... 0.02 $^1/_3$ gr.
   Sodium Chloride (sterilized).. 0.2 3 gr.
   Aq. Dest. .....100.0 $3^1/_3$ oz.
2. Cocain Hydrochlorat ..... 0.1 $1^2/_3$ gr.
   Morphine " ..... 0.02 $^1/_3$ gr.
   Sodium Chloride ..... 0.2 3 gr.
   Aq. Dest. .....100.0 $3^1/_3$ oz.
3. Cocain Hydrochlorat ..... 0.01 $^1/_6$ gr.
   Morphine " ..... 0.005 $^1/_{12}$ gr.
   Sodium Chloride ..... 0.2 3 gr.
   Aq. Dest. .....100.0 $3^1/_3$ oz.

METHODS OF USE.—Cocain may be injected by any of the methods previously detailed. Some operators use one method to the exclusion of others, while some use all methods, selecting the one best suited to the individual purpose. Endermic infiltration is perhaps most commonly used in this country. It presupposes an accurate knowledge of the sensitiveness of tissue and demands a greater accuracy of technic. By this method the skin is infiltrated by a $^1/_5$ of 1 percent. to $^1/_2$ of 1 percent. cocain solution to which may be added 5 to 15 drops of adrenalin solution (1:1000) to the ounce of fluid. The papillary layer of the skin is infiltrated after the method already described. The skin may be injected with a fair degree of intensity, forming a whitish ridge about the line of the needle, for in this way anesthesia is more certainly produced, and if the tissue is at once decongested by incision no harm can result. The width of the line of infiltration may be one-quarter to one-half of an inch or more. The anesthesia is complete as soon as the blanching appears. After the skin incision is made the deeper structures other than

the skin require each a special procedure, which will be taken up in the specific operations.

Anesthesia by edematization with cocain solutions as introduced by Schleich consists in the use of large amounts of weak solutions. The anesthetic effect is produced by pressure and by the 0.2 percent. salt which it contains, as much, perhaps, as by the cocain itself. This is particularly true of the No. 3 formula. The No. 2 solution of Schleich is usually employed when large areas of but slightly sensitive tissue are to be injected. A syringe holding several drams is most convenient. Matas has employed a special apparatus operated by compressed air. A large amount of the solution (up to a pint) is injected into the region of proposed operation in amounts sufficient to produce a veritable edema. The more tense the edema, the more perfect the anesthesia. It is safe to use in this manner two ounces of solution No. 2 and a pint of solution No. 3. This method is effectual and simple. It is the method by which many operations under local anesthesia are done. It has the advantage of being applicable where the exact distribution of the nerve is not known. The tissue so infiltrated admits of rougher handling, which is of advantage to the operator of limited experience. The distension produced by the edema some operators find objectionable, and it certainly is undesirable where identification or exact coaptation of structure is of importance, as in hernia operations. In certain operations, as in the enucleation of encapsulated tumors, this edema may be a positive advantage.

Amount of Fluid Used Key-note of Success

BLOCKING.—For this purpose a 1 percent. solution is recommended by Cushing. I have usually employed a $^1/_2$ percent. solution, the same as is used in infiltrat-

ing the skin. This obviates the necessity of having two solutions, though it acts less promptly than the stronger solution. The technic has already been described and is the same for all drugs.

TOXICOLOGY.—A word as to dangers or fatal results from very small amounts of cocain may not be amiss in this place. Ten drops of a 4 percent. solution used hypodermically have produced death. Eight drops of a 2 percent. solution produced violent symptoms in a girl of 12, and 4 minims of a $3^1/_2$ percent. solution produced convulsions followed by mania in a strong man. These instances are sufficient to show that very minute quantities may produce alarming symptoms and in spite of every care, unpleasant symptoms may arise. Only the amount of the drug actually entering the circulation is of consequence as an element of danger. In many instances in which toxic symptoms occurred it is impossible to estimate the amount of drug actually absorbed.

**Lethal Dose of Cocaine**

Because of this uncertainty the amount used should not exceed that which may safely be thrown into the circulation, notwithstanding the employment of methods intended to limit its absorption, such as prompt incision, the use of constricting bands, the addition of adrenalin, etc. Wood recommends that a total of three-quarters of a grain be not exceeded and that no more be used locally upon mucous membrane than would be used by hypodermic injection. If these amounts are not exceeded unpleasant results will rarely ensue.

**The Safe Maximum Dose**

TOXIC SYMPTOMS.—The symptoms of cocain poisoning manifest themselves without warning. They are pallor or slight cyanosis, often with restlessness and sometimes with a sense of impending disaster.

**Toxic Symptoms**

More rarely sudden collapse is the first symptom. These conditions may extend into unconsciousness.

In some instances fainting may follow the sight of blood, or the thought of the operation may cause the patient to become pale, which may excite in the mind of the operator the fear of cocain intoxication. A differential diagnosis is not always easy, but in simple syncope the subject's condition rarely assumes any other form than pallor, limpness and loss of consciousness. If cyanosis, dyspnea and sense of fear or great excitement appear it is safe to assume that intoxication has taken place. In persons who have never had the drug used upon them, special precautions are necessary. If repeatedly operated upon and they are found to bear the drug well larger doses may be risked.

The treatment of cocain poisoning is not a matter of great importance. If caution in prophylaxis is not used treatment will avail little. The patient should of course be laid down, if not already in the recumbent position, the clothing loosened and the respiratory action freed as much as possible from impediments. Strychnine in small doses may be used as an agent little calculated to do harm. Morphine, except for delirium, is of no use. When employed before the cocain is used it appears to have a certain prophylactic effect, but as a curative agent it is without power. For convulsions, chloroform may be used. Ether, administered by the drop method, on a mask has recently been employed and is believed to have a direct antidotal effect (J. E. Engstadt, Jour. A. M. A., 1910, March 19).

**Recumbent Posture and Fresh Air**

QUININE:—SALTS EMPLOYED.—The various soluble salts of quinine act as local anesthetics. I have employed quinine and urea hydrochloride ex-

clusively in my operative work and chiefly in the experimental researches. According to Schaefer (*The Druggist's Circular,* Feb. 1910), the salt is a combination of one molecule of quinine hydrochloride and one molecule of urea hydrochloride. The preparations upon the market are the powdered crystals. It is soluble in equal parts of water, forming a strongly acid solution. Schaefer states that for hypodermic use the solution should be freshly made in each case.

Quinine and Urea Hydrochloride Most Used

ACTION UPON THE TISSUES.—Since quinine promises to gain considerable prominence as a local anesthetic a short account of its action in the tissues may not be amiss. This is of importance in order that certain changes occurring in the tissues may not be misinterpreted.

When a soluble salt of quinine is injected into the tissue an exudation is caused which is at first amorphous, but which soon coagulates, forming a granular fibrin. This forms whenever the quinine solution is confined in the tissue. It begins after a few minutes and is complete in 12 to 24 hours. The skin so infiltrated is thickened and has a reddish color, giving a superficial resemblance to round cell infiltration. It is not tender to touch as would be the case in inflammatory reaction, and sections show no round cells. The fibrin occupies the spaces between the connective tissue fibrils, displacing them but leaving them for the most part unchanged. In the midst of such fibrin the connective tissue fibers do seem to lose their specific tinctorial reaction to a slight degree. The granular fibrin so produced is not organized into adult fibrous tissue as is the fibrillar type of fibrin as described in another place, but is absorbed after one or two weeks and the

Fibrinous Exudate Formed

Difference Between Quinine Reaction and Inflammation

tissues resume the state in which they were before the infiltration was made. When injected into the nerve sheaths the action is similar. The granular fibrin forms among the nerve fibres, displacing and compressing them. No changes capable of being detected within the nerve fibres are produced. This is of interest since it indicates that the solutions could be safely injected into mixed nerves for the relief of the pain.

The importance of keeping these changes in mind is, in the first place, that when reddening of the infiltrated skin occurs the conclusion will not be hastily formed that the reaction is an inflammatory one. More important still is the proper understanding of the results it is possible to obtain with the local use of quinine. If the skin is injected and at once incised the quinine solution escapes into the wound and the fibrin formation described above takes place to a slight degree only; anesthesia is of shorter duration and the wound healing occurs as though no local anesthetic had been used. Anesthesia does last, however, for several hours. This is the result to be aimed at in skin incision where anesthesia lasting not more than several hours and prompt healing of the wound are desired. If, on the other hand, primary union is not possible and prolonged anesthesia is desirable, it is important that the solution be allowed to remain in the tissue as long as possible in order that the exudate which becomes formed into granular fibrin, may take place. This exudate into the tissues, by prolonged pressure, prevents the oozing which follows certain wounds and to a certain degree the hemorrhage of the operation itself. The degree in which it lessens hemorrhage at the time of operation is directly dependent, other

things being equal, upon the amount of this exudate; which, in turn, is dependent upon the solution used and the length of time it is allowed to remain in the tissue. When this infiltration takes place anesthesia lasts from several days to two weeks or longer. These effects are desirable when primary union is not to be secured and when pain following the operation is a prominent feature. This applies particularly to operations about the anus, in the opening of abscesses and in a less degree in the throat.

In order to use quinine with satisfaction these actions of the drug must be kept in mind. That degree of reaction which is most desirable for the requirements of the given case may nearly always be obtained.

EXTERNAL APPLICATION.—Quinine has not been extensively used by topical application. It acts less promptly than cocain. Because of its irritative effect quinine is not desirable for use in the eye. The absolute safety and the duration of its action makes it desirable for use in the nose when a blanching of the surface is not required.

STRENGTH OF SOLUTION.—In strengths of 10 per-cent. to 20 percent. local anesthesia may be secured in mucous membranes; for the making of these stronger solutions the powdered crystals are preferable to the tablets.

METHODS OF USE.—The nose is the most frequent site for the local use of quinine. It is applied upon pledgets of cotton as described for cocain. Any desired amount may be used. The duration of the anesthesia may be in great measure controlled by the length of time the anesthetic is allowed to remain in contact with the mucous surfaces. When applied for acute coryza or hay fever it should be allowed to

remain for 15 to 30 minutes, while as a preliminary to therapeutic applications a shorter time will suffice. For destructive applications or operations the longer period is desirable. Because of the well known bitter taste of the drug, care to prevent its running into the mouth will be appreciated by the patient, for as Brewster wittily remarked, "they complain of the taste bitterly." The bladder may be satisfactorily anesthetized by the use of quinine and any amount may be safely used, and it may be allowed to remain in contact for any desired length of time. Further experimentation will be required before it can be definitely determined exactly what reliance can be placed upon this drug for this purpose.

BY INJECTION.—Quinine has found by far its most extensive use by injection. In general its employment does not differ essentially from that given for cocain, but the differences are sufficiently great to warrant a detailed consideration. It is more apt than cocain to cause burning when first injected. This lasts but a few seconds at most and may usually be entirely prevented by slow injection.

STRENGTH OF SOLUTION.—Quinine being safe in any strength it remains only to determine the amount of the drug that is necessary to produce the desired results. An extended use has proven that a one per-cent. solution is sufficient to produce anesthesia under any condition. Weaker solutions, $^1/_2$ percent. or even $^1/_4$ percent., give efficient anesthesia if skillfully used. When but temporary anesthesia is desired, and certain primary union with a minimum amount of scarring can be expected, as in operations about the face, these weaker solutions are to be preferred. Where prolonged anesthesia is desired, as in nearly all extensive operations, or where the tis-

**One Percent Need Not Be Exceeded**

sue is involved in a reactive irritation, the stronger solution is preferrable. We have never seen the advantage of the stronger solutions recommended by Brown (3 percent.), though in certain situations solutions of this strength are not particularly objectionable.

More Than Enough is Useless

METHODS OF USE.—Quinine is employed either for infiltration or for nerve blocking or for the modification of nerve blocking, perineural blocking. It is rarely used for edematization; first, because it is unnecessary for the production of anesthesia; and, second, it is undesirable because when quinine is thrown into the tissues the fibrinous exudate previously described may be formed in large amounts. This produces an edema which lasts for a week or longer, and while it results in no permanent mischief it calls forth expressions of curiosity or alarm from the patient. These objections apply, let it be understood, only when large amounts, as several ounces, are injected into the loose cellular tissues. There are a few instances in which edematization with quinine is desirable. These will receive specific mention in the discussion of those operations where it is to be recommended.

As soon as the injection is completed the operation may be begun, as is the case with cocain. An exception to this general statement must be made in case of perineural blocking, for anesthesia under these circumstances is sometimes not complete until after a lapse of 10 or more minutes. It is my practice not to delay the operation at any stage for the purpose of permitting the anesthetic to act but to continue the operation leisurely without interruption. By a little foresight it is possible to occupy the time as in making ligatures, while some recently injected

anesthetized area is being influenced by the anesthetic. Under certain circumstances, for instance where prolonged anesthesia is desired or where it is desired to prevent post-operative oozing, the solution should be allowed to remain in contact with the tissues in order that the fibrinous exudate may form before the operation is begun. This is well established in a period varying from five to thirty minutes and becomes much more complete if many times the period mentioned are allowed to elapse before the operation is begun.

NOVOCAIN.—(Braun, *Beitr. z. klin. Chir.*, 1909, lxii, 641.) This drug is said to be less toxic than cocain (1 :7) and quite as efficient in 1 to 2 percent. solutions. It does not cause vascular constriction but does have a preliminary vaso-dilator action and bears boiling. Like quinine, it is more apt than cocain to cause slight burning when first injected. Its toxic action is represented by tonic or clonic spasms. Its maximum dose is placed at 7 grains. The duration of the anesthesia is less than cocain. When used alone it loses its effect after 15 minutes. The action is more prolonged if adrenalin is added, but even with this addition its action cannot be depended upon after 20 or at most 25 minutes. Fischer (*Die lokale Anesthesie in der Zahnheilkunde;* Meusser, Berlin, 1911) recommends novocain very strongly. He advises the addition of thymol both for its preserving effect and because it is itself a local anesthetic. He recommends the following solution:

Maximum Dose

| | |
|---|---|
| Novocain | 1.5 |
| Sodium Chlor. | 0.92 |
| Thymol | 0.025 |
| Aq. Dist. | 100.0 |

This makes a $1^1/_2$ percent. novocain in normal

salt solution to which $^1/_3$ Gr. thymol has been added to each 100cc. To this adrenalin may be added at the time of use.

Piquand (*L'anesthésie locale,* Paris, Dain et fils, 1911) recommends the following solution very highly:

| | |
|---|---|
| Normal saline | 100.0 |
| Novocain | 0.50 |
| Adrenalin (1.1000) | gtt. 25. |

Novocain stands midway between cocain and quinine. It is safer than the former, much less safe than the latter. Like quinine it is attended by a preliminary vascular dilatation, but this dilatation is of shorter duration than after quinine. Like quinine it disturbs wound healing slightly if unskillfully used. Its duration is too short to be useful in controlling after-pain. This drug in very recent years is perhaps more generally used than any other, and for short operations is satisfactory.

STOVAIN.—(Braun, *Münch. Med. Woch.*, 1905, lii, 1177; Kendirdjy, *L'anesthésia chirurgicale par la Stovaïn.* Paris, Masson et Cie., 1906.) This drug has found its chief use in spinal anesthesia, but it has also been used in local anesthesia. It is less toxic and less efficient than cocain. It is said to work better in inflamed tissue than cocain. In many instances it works satisfactorily and again without explanation results are not satisfactory. One is justified in regarding such statements as reflecting more on the technic of the surgeon than on the efficiency of the drug. This drug may be used as novocain. It has been added to alcohol for injection into neuralgic nerves (Ostwald, *Presse Médicale,* Dec. 16, 1905).

OTHER DRUGS USED.—Because of the well recognized dangers attending the use of cocain a large number of drugs have been introduced which it was hoped would be as efficient as cocain but devoid of of its dangers. Several of these have, as a matter of fact, gained a wide popularity. None of them is, however, as efficient as cocain, and since the weak solutions of cocain recommended by Schleich have very materially reduced the dangers of cocain the newer remedies, save novocain, have failed to come into popular use. Among these substitutes for cocain, *beta-eucain* has been most extensively used. Three grains of this drug may be employed with perfect safety, it is said, and as much as 15 grains have been used without alarming effects. It may be used in the same strength as cocain in Schleich solutions or in 1 percent. for infiltration. For local application in the eye or nose, solutions of 2 percent. are used. *Tropococain* has been used in similar strengths and is said to be safe up to five grains. Among other drugs used may be mentioned *anesthesine*, *subcutin*, and *alpin*. It is difficult to determine the efficiency of these drugs as local anesthetics for, as pointed out by Schleich, 0.2 percent. salt solution or even pure water act as local anesthetics when the tissue is distended with them.

Beta-Eucain

Tropococain

Anesthesin, Subcutin, Alpin

That pure water injected into the tissues will effect anesthesia was demonstrated by Schleich, and it has been made use of in practice by S. G. Glant. He uses it in operations about the rectum. In order to secure anesthesia by means of water it is necessary to inject the tissue so tensely that it becomes thoroughly blanched. The injection itself frequently causes acute pain. This may be lessened by pressing the tissue as it is being injected firmly between the

thumb and finger. This means of securing anesthesia has an extremely limited field of usefulness and can be recommended only for operations of short duration when other means are not at hand.

THE USE OF ADRENALIN AS AN AID IN LOCAL ANESTHESIA.—The credit perhaps is due to Braun more than to anyone else for having discovered the usefulness of adrenalin as an adjunct to solutions used for local anesthesia. It was by means of this drug that he hoped to lessen the rate of absorption of cocain, thus rendering it at once safer and more effective. Its chief use perhaps is to lessen hemorrhage, and many believe that it prolongs the action of the anesthetic. Sickenburg denies that adrenalin makes cocain either safer or more efficient. Usually from 5 to 15 drops of the 1:1000 adrenalin solution are added to an ounce of the Schleich mixture. Fischer believes that not more than 7 minims should be used at one operation. Intoxication may be produced though the results are not serious. The symptoms are palpitation, cardiac spasm and dyspnœa. Toxic symptoms are more apt to manifest themselves if the solution is injected directly into a vein, likewise old solutions are more toxic than fresh ones. Braun used from 1 percent. to 5 percent. cocain solution to which he added adrenalin sufficient to make it 1:1000. Barker used adrenalin with beta-eucain with great satisfaction. It must be admitted that the addition of the adrenalin does lessen hemorrhage and probably lessens the rate of absorption and increases the effectiveness of the anesthetic. These results are unquestionably an advantage during the course of the operation. The action is but temporary and it has seemed to me that the disposition to ooze when the effects of the drug have

Method of Action

Maximum Dose

disappeared is greater than when it has not been used at all. In this way unpleasant subcutaneous hematomas may form after the skin incision has been closed or prolonged oozing may ensue from superficial wounds, as after operations upon the nose and throat. I prefer to encounter hemorrhage at the time of operation, when it can be controlled by other means, rather than be annoyed with oozing after the operation has been completed. To the beginner the use of adrenalin may be recommended because of the greater ease of operation it secures.

Disadvantages

Added to quinine solution adrenalin has a very interesting result inasmuch as it limits the amount of fibrin produced. For this reason it may be advantageously added in regions where the induration produced by quinine used alone is undesirable. It should be noted that the duration of anesthesia is much reduced and where after-pain is considerable this is undesirable. Adrenalin when added to quinine lessens the hemorrhage and prevents in a measure the primary dilatation of the vessels produced by that drug. Each region and operation has requirements peculiar to itself, and when modifications in the solution are required they will be mentioned in the specific operations.

Modified Quinine Solution

COMBINED LOCAL AND GENERAL ANESTHESIA.—For a long time general anesthesia has been employed in particularly painful stages where local anesthesia was used for the major portion of the anesthetic. Thus a few whiffs of chloroform are often given in thyroidectomy when the lobe is being dislocated. Generally speaking, the need of a general anesthetic is inversely proportional to the skill of the surgeon in the use of local anesthesia.

With the advent of quinine as a local anesthetic

the association of local and general anesthetics has found a new application. Rogers first proposed (verbal communication, 1908) that when operations are done under general anesthesia those areas likely to be attended by marked after-pain should be injected with quinine for the sole purpose of lessening the suffering after the patient comes from under the anesthetic, as when hemorrhoids are tied off in the course of a major gynecological operation, or if hemorrhoids are operated under general anesthesia as the operation of choice. It lessens the pain materially to inject the areas ligated. Likewise nerves that have been severed as in an amputation, may be injected in order to limit the shock.

Hyperesthesia May Be Mistaken for Failure of Anesthesia

SECONDARY EFFECTS OF LOCAL ANESTHETICS.—A commonly overlooked accompaniment of local anesthesia is the zone of hyperesthesia about the area anesthetized. An area varying from $^1/_4$ to $^1/_2$ inch or more immediately beyond the anesthetized area ordinarily becomes excessively hyperesthetized. It is a hyperesthesia of touch and not of pain. The cause of this phenomenon is not understood, but the importance of recognizing it is great. If it is overlooked the touching or pressure upon this zone may cause acute suffering and the operator may believe that anesthesia of the site of injection is insufficient or has already disappeared. This hyperesthesia often lasts a day or two or even longer.

FREEZING.—Aside from the extreme limitation of usefulness of freezing as a means of producing insensibility to pain, is the fact that when the tissues thaw out severe pain results, quite independent of any pain which may be attendant upon the operation itself. The method has a certain use, however, but

it is limited to the skin for small areas and for operations of short duration.

METHODS.—Refrigeration sufficient to make the skin insensible may be secured by means of ice and salt. The salt is pressed against the skin with a piece of ice the size of a walnut. After a few minutes the skin becomes insensitive. This method has been used for simple puncture, as in thoracic paracentesis, in the absence of more suitable material. For timid patients it has the advantage, as have all methods of freezing, that the anesthesia

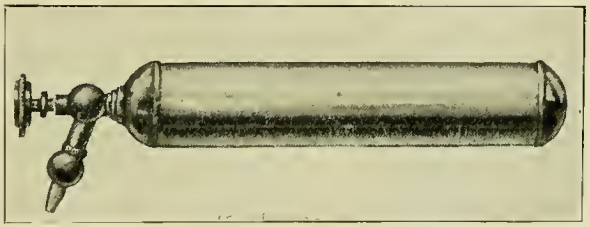


Fig. 9. Ethyl chloride container for freezing.

can be produced without pain. The fact that the patient suffers more from the thawing than from the operation itself is not a contra-indication sufficient to prevent its use in such persons. Volatile substances are usually used when it is desired to produce local anesthesia by the abstraction of heat. Ether spray used after the method of a freezing microtome may be employed. Ethyl chloride has been most used, however, and is preferable. This is placed upon the market in small containers (Fig. 9) fitted with a cap or valve which prevents evaporation when not in use. These containers are of such size and form as to fit the hand, the warmth

of which, when the receptacle is grasped, hastens the evaporation of the chemical and thus refrigeration. By means of this apparatus a small area of skin may be frozen in a few seconds. The proper degree of refrigeration has been reached when the skin becomes frosty. Freezing beyond this stage does not increase the anesthesia and may lead to sloughing. The instruments needed for accomplishing the desired therapeutic purpose should be previously arranged so that the necessary operation may be carried out without loss of time since the duration of the anesthesia is limited almost entirely to the opening of small abscesses or the anesthetization of the skin preliminary to the making of a puncture of the needle for local anesthesia as recommended by Schleich. Here it serves a very useful purpose, since it eliminates the initial pain of infiltration anesthesia; or, conversely infiltration anesthesia may be used to prevent the pain caused by the thawing out of the tissues after freezing. By the combination of these two methods it is possible to carry out painlessly procedures otherwise very painful. Freezing should not be employed preliminary to incision where primary union is desired, since the freezing of the tissue so disturbs the vitality that primary union is likely to be interfered with.

Excessive Action Causes Sloughing

Limit of Usefulness

SELECTION OF AN ANESTHETIC.—For me, quinine and urea hydrochloride has become the anesthetic of choice. It has to commend it absolute safety, efficiency and cheapness. It finds its particular indication for use in those regions where post-operative pain is considerable and prolonged. In those regions where cosmetic results are of prime importance and where a small amount of solution is sufficient cocain offers perhaps some advantages, for

Quinine Most Useful

quinine does sometimes, because of the fibrous exudate, cause a slight delay in wound healing. In operations about the nose a satisfactory degree of anesthesia may be obtained by quinine, but it does not cause any constriction of the mucous membrane. This is a disadvantage when contraction of turgescent turbinates is desired in order to enable the examiner to obtain a better view of the deeper parts of the nose. Whether quinine is as efficient as cocain for use in the bladder I do not know, for I have never had the courage to use cocain in sufficient amounts to test its merits. Cocain is no doubt the quicker and more certain drug in its action. That it causes contraction of the bloodvessels is in itself an advantage for examination in certain conditions. If carefully used in small amounts, the danger in its use is not great. Since the amount absorbed can never be definitely determined, it is well to heed the admonition of Wood never to exceed three-quarters of a grain by injection. We have placed the limit at one grain and have never experienced unhappy results after many years of constant use. Since learning the value of quinine I resort to cocain only under special indications; for while I experienced no disasters in the use of cocain there was always present the fear of disaster and the constant knowledge that a certain amount of the solution dare not be exceeded, limitations which are happily absent when quinine is used. Though the dangers in the use of cocain are very slight when used with the precautions above indicated, let it be repeated, they are never absent. For use in small operations about the mouth and face I still employ cocain. For extensive operations in these regions quinine has the preference.

Cocaine Indicated When Amount Required is Small

With the other drugs employed in local anesthesia I have not had an extended experience. There is a general agreement that they are less dangerous than cocain and also less efficient. Of the other drugs novocain has no doubt enjoyed the greatest popularity. It is efficient and in the strengths given is quite safe. It causes but little local reaction and where certain and accurate union is desired is superior to quinine. The duration of anesthesia is brief and where after-pain is a factor does not compare with the latter in efficiency and, though quite safe with reasonable care, does not approach quinine in its absolute safety.

**Novocain Useful in Short Operations not Attended by After-pain**

In individual operations certain anesthetics have a special indication. These will be pointed out in their proper place. Much depends upon the proper selection of the drug, its strength and the proper technic of its employment. We are but on the threshold of the development of local anesthesia, and a careful attention to details will do much to hasten a general recognition of its efficiency.

# CHAPTER V

## Opening Abscesses

The surgical treatment of suppurative processes seeks to accomplish one of two purposes: First, to permit the escape of pus. Second, to limit the infective process. Here the incision is made before the suppuration has become localized. In the former case the wall of the pus cyst only requires incision, and the area involved in the operation is small. In the latter case tissues which are in a highly inflamed state and are therefore hypersensitive must be incised, and this demands much more efficient methods then does the simple opening for drainage. The simpler operation may nearly always be done under local anesthesia, while the latter often demands general anesthesia.

Generally speaking, inflammatory tissue is anesthetized with difficulty. This is due to the slow and painful diffusion of the anesthetizing fluid within the inflammatory area, already congested and tense. It follows that easily diffusible fluids should be employed and the force exerted should be such that the anesthetic acts under low pressure. Cocain diffuses more readily than other anesthetics and is safe in small abscesses. It is used in $^1/_2$ to 1 percent. solution. Quinine and novocain are efficient in 1 percent. strength. Inflamed tissue is painful not alone at the time it is incised but for a variable time afterward. In quinine we have a means of controlling the after-pain until the processes of repair are well advanced. For this reason and because of its

**Selection of the Anesthetic**

safety it is the drug of election for use in all but the smallest abscesses.

Method of Injection

If the area is small we may circumscribe it, making the injections into the healthy skin. If it is on an extremity, as on the finger, we may infiltrate the finger at its base, thus anesthetizing the entire diseased member. Often the inflamed region is too extensive to permit this technic, as when the forearm or a large area of the back or abdomen is involved. In this instance a line must be infiltrated over the summit of the affected part. The infiltration is begun at the border in the confines of normal skin and is gradually extended over the summit of the tumor. If great gentleness is exercised and the infiltration is done slowly little pain may result. The question has been raised whether or not there is danger of spreading the infection by the puncture of the needle. There is no evidence to show there is such danger. The tissue is already fully protected from invasion by the leucocyte infiltration during the formation of the abscess.

When the area has been anesthetized the abscess is incised. A free incision should always be made, the extent required must be anticipated when the infiltration is made. Each region possesses modifications in character requiring a different technic. The varying details will be taken up in the consideration of regional operations.

Contra-indications

Some cases are unsuited to local anesthesia. Patients afflicted with abscesses of magnitude rarely present strong contra-indications to general anesthesia. Yet they bear pain badly, because their sleep and nutrition have been interfered with; and unless the extent of the operation is definitely known and it is certain that it can be well done without

pain, a general anesthetic should be selected. Severe infections of the extremities involving fascial planes or tendon sheaths or where unsuspected sinuses are apt to be encountered should not be attempted under local anesthesia, for often the attempt results in imperfect work. Extensive inflammations, like malignant tumors, are problems of major surgery, demanding general anesthesia, and the exercise of boldness and judgment combined with the highest degree of skill.

THE REMOVAL OF TUMORS.—Those who recommend the removal of tumors under local anesthesia assume a grave responsibility. No operation that cannot be clearly defined before it is begun should be undertaken under local anesthesia. No operations are so difficult to anticipate as those for tumors. No class of operations places such a heavy requirement upon the operator's skill. When operating under general anesthesia the operator is at liberty to change his line of attack at any period of the operation. With local anesthesia the matter is different. If the operation, as planned, proves inadequate to meet the conditions the operation is very apt to be completed according to the limits of the anesthetic rather than according to the indications presented by the tumor. It has been my lot to perform many utterly hopeless operations secondary to local removal of malignant tumors.

Limitations of Local Anesthesia

As a safe guide the dictum may be accepted that all benign tumors may be removed under local anesthesia and conversely it is never permissible to operate a malignant tumor under local anesthesia. The terms malignancy and benignancy are used here in their biological and not in their clinical sense.

The biological feature that makes it permissible

to operate benign tumors under local anesthesia is that they are expansile tumors and in consequence are encapsulated and loosely attached to the surrounding tissue, so that it is possible to determine accurately beforehand the exact confines of the operation.

The matter of dealing with the surface covering is already familiar. Endermic infiltration is preferable where it can be used as in the skin or thick

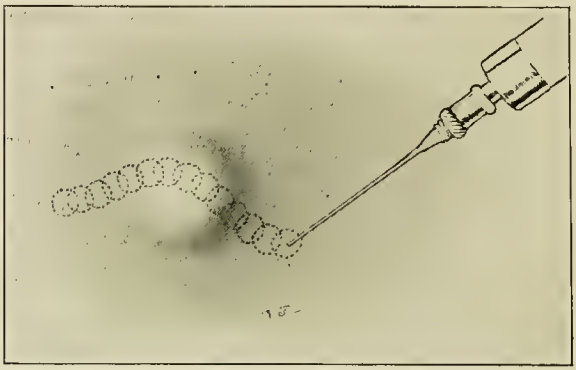


Fig. 10. Showing the line of infiltration over the summit of a wen.

mucous membranes; otherwise the subdermic method may be used.

The Line of Incision

The lines of the incision are determined by the form of the tumor. Benign tumors for the most part present an elevation above the surface. Ordinarily, if this elevation represents half a sphere or less, the most satisfactory incision is a straight line over the summit (Fig. 10). If the projection is more than a hemisphere a more or less constricted base is presented and an elliptical incision is made permitting the delivery of the tumor but retaining enough

skin to close over the wound when sutured. The line of infiltration is made clear by the figure (Fig. 11).

Method of Infiltration

The tissue beyond the capsule is best made insensitive by edematization. This not only is the most

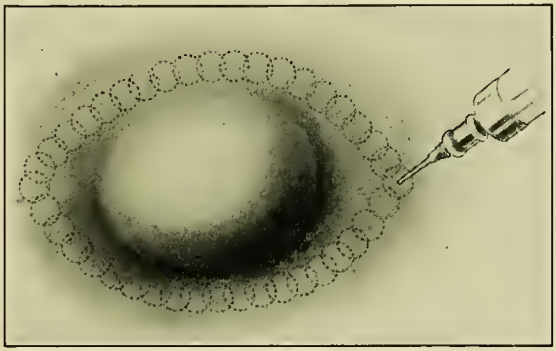


Fig. 11. Showing line of infiltration about the base of a tumor.

effective manner to secure local anesthesia but the edematization facilitates removal inasmuch as it accurately defines the line of least resistance. The best

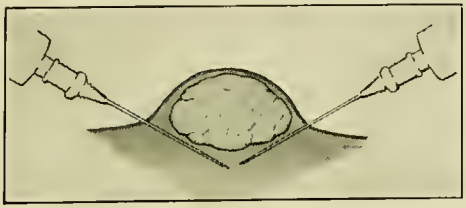


Fig. 12. Showing method of edematization of the base of a tumor.

manner of securing edematization depends on the size of the tumor. In small tumors a deep injection beneath the tumor from each end of the line of skin infiltration (Fig. 12) is sufficient. Lateral deep infiltrations made from various points of the primary

line suffice in large tumors. Tumors circumscribed by an ellipse may be infiltrated about the base through this line. In large deeply seated tumors injections may be made beneath the tumor outside of the line of skin infiltration.

The removal of the tumor leaves more or less of a cavity. Unless the surrounding soft parts can be made to fill the space occupied by the tumor the cavity should be drained lest fluid accumulate and invite suppuration.

Anesthetic of Choice

The anesthetic of choice for small tumors in exposed parts (face, hands) is cocain. For large tumors presenting difficulties in removal quinine has the distinct preference.

By the observance of these simple rules the technic may be varied to suit any encapsulated tumor. As a matter of practice, however, very few tumors are thus ideally encapsulated and the technic must be varied for different modifications. It seems worth while therefore to consider the chief groups of tumors and note their peculiarities.

WENS.—These tumors are encapsulated save that they are intimately attached to the overlying skin. In smaller wens a straight line may be defined over them. If the cyst be opened the cyst wall may be removed secondarily. Usually an elliptical incision is preferable, so that as much of the skin as is attached to the tumor may be removed.

Avoid Opening Cyst

DERMOIDS.—These tumors are not attached to the skin but often have perplexing deep attachments. A simple skin incision over the summit is sufficient for all purposes; but the deep portion should be infiltrated with care, particularly when lying upon bone, as over the cranium. Dermoids, especially those of the sacrum, are apt to have processes lead-

Infiltrate Base Carefully

ing to unsuspected places. For these reasons, while the surface incision may be simple it must be long enough so as to permit free access to the base of the tumor.

LIPOMAS.—These tumors are apt to prove more difficult during operation than anticipated. Lobulations not detected by palpilation may be discovered at operation. The incision should, therefore, be ample. Again hemorrhage, nearly always from the base, may prove troublesome. The base should be well infiltrated. The surface incision being made, the tumor is dislocated towards its base. Dull dissection will usually permit the clamping of the blood vessels before they are severed. This facilitates hemostasis for often the vessels retract when cut, making their recoverey difficult, doubly so if the base of the tumor has not been well infiltrated. With these precautions in mind lipomas of any size may be satisfactorily removed under local anesthesia.

Accurate Hemostasis Required

PAPILLOMAS.—This term may be made to cover those tumors which are a part of the skin and project from it. Elliptical infiltration about the base with the injection of a few drops beneath it permits removal through the entire thickness of skin. The bleeding is often profuse either from the base or from the cut edge of skin if the operation be in a very vascular area such as the scalp. This is the only operation for tumors in which it is permissible to make a coaptation suture serve as a hemostatic agent as well. Deep sutures, preferably figure of 8, usually control the hemorrhage. If quinine is used as the anesthetic the placing of sutures thus tightly is not followed by after-pain as is the case when cocain is used. With papillomas may be classed melanomas, which are usually more

Careful Skin Coaptation Assures Hemostasis

or less elevated. In their removal a wide margin of skin should be removed and in injecting their base the needle should be passed well beneath and not into the base of the tumor.

Other small endermic tumors, as angiomas, which are usually not encapsulated, may be removed in like manner.

GANGLIA.—The synovial sacculations, occurring most frequently about the extensor tendons of the wrist, demand in their removal absolute asepsis and rapid healing. Novocain which permits sterilization by boiling is the ideal anesthetic. The cyst is infiltrated over its summit and about its base. It is dissected free from the skin and off the tendon sheath. The skin must be carefully closed.

Absolute Asepsis Required

In addition to the distinctly benign tumors are others which have a benign stage and these when encountered in this period may be removed under local anesthesia. In the operation of these tumors much responsibility rests on the diagnostic skill of the operator.

ADENOMAS.—Certain skin adenomas forming small nodular tumors together with a part of the skin may be removed by circumscribing the attached skin as well as injecting the capsule and the surrounding tissue. It is not enough that the tumor be shelled out; but the capsule must be excised as well. This demands a more extensive infiltration about the tumor.

Capsule Must Be Removed

MIXED TUMORS.—Certain tumors of the breast belonging to this class may be removed under local anesthesia. In a very early stage the expert may assume the liberty of shelling the tumor from its bed, but as a general proposition one must declare for the removal of the tumor and capsule whether

it be clinically a fibro-adenoma or its near relative, the mixed tumor. After rapid growth has taken place they are subjects for radical operations under general anesthesia.

What has been said here applies to other mixed tumors, namely those of the parotid and the submaxillary gland. These present certain technical difficulties which may cause the operator to lean to his own convenience and demand a general anesthetic. The mixed tumors of the testicle are rarely diagnosed before the stage of rapid growth and then demand removal of the abdominal glands which requires a general anesthetic.

ENDOTHELIOMAS.—Endotheliomas of the skin often appear as slowly growing globular or sessile tumors covered with normal skin or by vascular mucous membrane-like skin. These may be removed by a wide ellipse extending wide of any suspicion of tumor tissue. Even with this precaution local recurrence will be encountered from time to time demanding a repetition of the operation.

**Large Margin of Skin Must Be Removed**

RECURRENCES.—In some instances the removal of recurrent malignant tumors under local anesthesia may be justified. Save for the endotheliomas these operations are rarely more than palliative. But palliation may be a source of satisfaction to the patient. Recurrent carcinomas of the breast and sarcomas of the neck have been repeatedly removed to the satisfaction of the patient. These operations done as they are in the scar tissues require especial care in anesthetization. The scars themselves cannot be anesthetized and it is necessary to infiltrate the tissue about the scars thus blocking them off from the surrounding nerves. Quinine is far superior to any other anesthetic for this purpose.

Other palliative operations, such as cauterization or curetage, may be made painless by means of a local anesthetic.

TUMORS IN WHICH LOCAL ANESTHESIA IS CONTRAINDICATED.—It has already been stated that malignant tumors belong to the realm of major surgery and should be operated only under general anesthesia which permits the removal of the subjacent glands. I desire to mention specifically that this injunction applies to beginning epitheliomas of the lip and tongue. The task of removing a small wedge containing the tumor is so fascinating that it is only by remembering the almost certain recurrence in the lymph glands that the operator will be deterred from acceding to the desire of the patient for the simple operation.

Limitation of Local Anesthesia

The single exception to this rule is the basal-celled epitheliomas occurring on the face. These, if the services of a competent x-ray operator are not at hand, may be removed under local anesthesia.

I am aware that a number of articles have been published in recent years recommending local anesthesia for extensive operations for malignant disease, notably extensive growths of the neck and for resections of the jaws. These extensive operations are possible in the hands of the skilled operator, but in other hands imperfect operations are certain to result. Until the knowledge of the operator transcends the range of this booklet these excessive operations had best not be undertaken. To those of extensive experience in the use of local anesthesia such operation may often be done with advantage; at least such operators are beyond the range of pedagogical responsibility.

When Extensive Operations Are Permissible

# CHAPTER VI

## Operations upon the Cranium and Face

The head offers a particularly favorable field for local anesthesia because of the superficial location and accessibility of the nerves. Nearly all operations except those for malignant disease have been successfully carried out. It is particularly satisfactory for the removal of the numerous tumors which are excised for cosmetic reasons. Slight injuries may be conveniently treated under local anesthesia and many of the severer injuries absolutely demand the use of a local anesthetic, particularly when internal injuries or shock make the use of general anesthesia extra-hazardous.

Indications

Operations on the cranial soft parts.—Nerve supply.—The nerve supply of the scalp is definite, easily accessible and constant, all of which go to make anesthesia by nerve blocking efficient. The difficulty is that the deeper parts are supplied by twigs given off before the nerves are accessible for blocking. These factors make a knowledge of the nerve supply necessary. The chief supply for the scalp is the auricular and supraorbital nerves, with minor branches in the temporal region (Fig. 13). These may be taken up in order.

Nerve Blocking Ideal Method

1. *Auricularis Magnus.* This nerve is a branch of the first cervical nerve and reaches the cranium at a point midway between the occipital protuberance and the mastoid process, where it lies below the muscle directly upon the periosteum. It courses

directly over the periosteum and anastomosis with the supraorbital nerve at the vault of the cranium. It is most conveniently blocked at the point above mentioned. The injection must be made deeply beneath the muscle. Further up in its course it is more superficial and at the superior curved line may be reached with an ordinary hypodermic needle.

Fig. 13. The nerve supply of the scalp and face.

2. *Occipitalis Minor.* This nerve, a branch of the second cervical nerve, reaches the cranium immediately back of the mastoid where it lies beneath the skin and fascia and can be easily reached.

3. *Supraorbital and Frontal.* These nerves are branches of the first branch of the fifth cranial nerve. The former reaches the forehead by a notch or foramen at the middle of the supraorbital ridge

while the latter becomes superficial just lateral to the glabella. Both these nerves can be accurately located. They supply the forehead and anterior portion of the cranium, anastomosing with the occipital nerves at the vault.

4. *The auriculo-temporal.* This nerve, a branch of the third division of the fifth nerve, becomes superficial just below the zygomatic arch and supplies the anterior cranial quadrant. Anterior to this nerve is a small branch of the second division of the fifth, the zygomatic, which supplies the region about the external canthus of the eye.

In extensive lesions of the cranial vault blocking of these nerves at their origin may be undertaken. In lesions of the regions supplied by one or two only a lesser injection is needed. The diffuse anastomosis of many of these nerves makes blocking somewhat uncertain when the area of operation is near the termination of any particular nerve. For this reason if the lesion is not very extensive the injection of a line deeply about the region to be operated is simpler and always sufficient.

**Long Needle Required**

The technic varies with the kind of lesion, which may therefore be taken up in order.

THE REMOVAL OF TUMORS.—PAPILLOMAS.—Warty growths are frequently objects for surgical interference. Because of the deep involvement of the skin the incision must be made entirely through this structure. An ellipse is injected about the base, the entire thickness of the skin being infiltrated and a few drops of the fluid should be injected beneath the growth. This latter precaution is necessary since there is usually a vessel of considerable size at the base which requires ligation. Hemorrhage, when but moderate, may be controlled by the su-

**Method of Infiltration**

tures, which preferably should be of non-absorbable material.

WENS.—Atheromatous cysts are common upon the scalp. They are sacculated sebaceous glands and are free from the skin except at their summit. When small they may be removed by an incision over the apex with a secondary removal of the sack. Larger wens should be removed by an elliptical incision about the base of the tumor. In the first instance the skin is infiltrated over the summit and from the ends of this line injections are made beneath the tumor. In larger growths an ellipse is injected surrounding the tumor and all tissue contiguous to and beneath the tumor is abundantly infiltrated. This infiltration loosens the tumor from its surroundings and facilitates its removal. The skin after hemostasis is closed by sutures.

Free Infiltration Facilitates Removal

DERMOIDS.—Dermoids are found about the great fontanelle and in the temporal and mastoid regions. The skin is free, but the tumors are often intimately associated with the periosteum. The latter structure particularly requires careful infiltration, which may be accomplished by passing the needle immediately over the bone. A simple incision over the summit or an elliptical incision as in wens, may be employed. It is easy to deflect the skin from the tumor, but an elevator may be necessary in order to elevate the base of the sac from the bone upon which it lies.

WOUNDS OF THE CRANIAL SOFT PARTS.—The proper repair of scalp wounds often demands careful cleansing and removal of lacerated and contaminated tissue. If the wounded area is extensive, anesthesia may be produced by nerve blocking, or if small, a line may be circumscribed about the area. It has been recommended in simple wounds that the syringe

needle be introduced through the edge of the wound. Multiple punctures in sensitive skin are necessary and it is also necessary each time to traverse the infected edge of the wound. In simple wounds that do not require trimming the sutures may be passed quite as well without anesthesia since the pain inflicted is but momentary.

In Small Wounds No Anesthetic Required

OPERATIONS UPON THE SKULL.—Local anesthesia will not be selected for operations upon the skull unless there is a special contra-indication against general anesthesia. Not infrequently in severe injuries an intracranial hemorrhage demanding attention is complicated by other injuries, notably thoracic, making inhalation anesthesia extra-hazardous.

When Indicated

The cranial soft parts are anesthetized either by nerve blocking or by infiltrating a line about the area to be operated upon. Abundant fluid should be deposited upon the bone under as great pressure as possible in order to aid diffusion into the vessels traversing the bone. At least ten minutes should be allowed for diffusion to take place. The usual horseshoe incision is made and the soft parts elevated from the bone. The trephine is the instrument of choice as the jarring of the chisel makes this instrument unsuitable. If there is a depression within the bone the trephine, if placed over the loosened fragments, may still further depress them into the skull. A button should be removed alongside of the depressed bone in such instances. When this is done the depressed bone may be elevated or removed. Should it be necessary to open the dura mater it can be incised without pain and manipulated in the usual way.

Method of Infiltration

OPERATIONS UPON THE FACE.—The lesions of the face operable under local anesthesia are

**Range of Operations**

few in number aside from the tumors. Wens and connective tissue tumors are occasionally presented for removal, but the majority of lesions are epithelial in character. Benign tumors may be easily removed by injecting a few drops of anesthetic at their base and excising by an elliptical incision. The only malignant tumors, the removal of which is permissible under local anesthesia, are the basal-celled carcinomas of the face. Simple infiltration about the base makes it possible to remove them by an elliptical incision.

**Anesthetic of Choice**

Cosmetic results are prime factors in operations about the face and because of this cocain remains the anesthetic of choice. Unless the growth be large, requiring the use of a considerable amount of fluid, adrenalin had better be omitted.

The face and lips are easily anesthetized permitting any operation to be satisfactorily performed. Small plastic operations and the exposure of nerves are easily accomplished.

Plastic operations can be easily performed in adults, but not in children. If procedures of some magnitude are to be undertaken the infraorbital and mental nerves may be blocked at their point of exit, and usually a circular infiltration as well will be required.

## CHAPTER VII

### Operations Upon the Ear and Mastoid

FURUNCULOSIS OF THE EXTERNAL MEATUS.—This exceedingly painful affection is difficult to anesthetize. The local anesthetics mentioned below for application to the tympanic membrane give partial anesthesia. A cautious infiltration beginning well beyond the affected area gives better results; but there is no point in the body where such gentle manipulation is necessary in order to avoid pressure pain from the fluid. If the furuncle is deeply seated the injection may be begun at the outer extremity of the canal and the seat of the lesion approached. If the lesion is near the outer extremity of the canal the injection may be begun behind the ear and the site of the lesion gradually approached. Cocain and adrenalin is the best anesthetic to use.

Greatest Gentleness Required

PARACENTESIS.—Various means have been employed to lessen the pain of operations upon the drum membrane. In most of these solutions carbolic acid and cocain enters. The solution recommended by Hechinger is as follows:

Solutions Used

| | | |
|---|---|---|
| Acid Carbolic 95% | | gr. vii. |
| Cocain | | |
| Menthol | aa | gr. xxx. |
| Alcohol | | dr. iiss. |

A bit of cotton is saturated with this solution and pressed against the tympanic membrane for a few minutes. This may be followed by injection through the membrane. Bonain uses a stronger solution of carbolic acid, as follows:

Phenol crystals
Menthol
Cocain aa 1 gram

To this may be added several drops of adrenalin.

Usually no attempt at injection is worth while since the operation of incising the membrane is no more painful than are the injections to produce anesthesia. Very strong cocain (20%) and adrenalin solutions have been employed for the local application. The small amount required makes these strong solutions safe. These same solutions are used in furunculosis of the external canal.

MASTOID OPERATION.—Operations upon the mastoid are not infrequently demanded as the result of complications with other diseases, notably typhoid and scarlet fevers and respiratory diseases, conditions in which general anesthetics are distinctly contra-indicated. Some otologists use local anesthetics as a matter of choice. My own experience has been confined to those cases in which a general anesthetic was contra-indicated or when it was necessary to treat ambulant patients.

Indications

In order to operate satisfactorily upon the mastoid under local anesthesia a complete comprehension of the difficulties involved is necessary, whether a simple opening into the cells is anticipated or an attempt is to be made to do a complete radical operation. Often when the mastoid is involved as a complication to a severe general disease simple palliation is aimed at. In such instances the more elaborate anesthetization is not necessary.

The skin covering the region of the mastoid is supplied by the great auricular and the auriculotemporal nerves. The tympanum receives in addition filaments from the glossopharyngeus and the

Nerve Supply

vagus. The nerve supply is too much diffused to permit nerve blocking and infiltration must be depended upon.

The following method may be employed. A line is infiltrated in the skin beginning below the tip of the mastoid and describing a curve round the ear about 1 centimeter from it and ending well above the ear. Following this the periosteum is tensely in-

Method of Infiltration

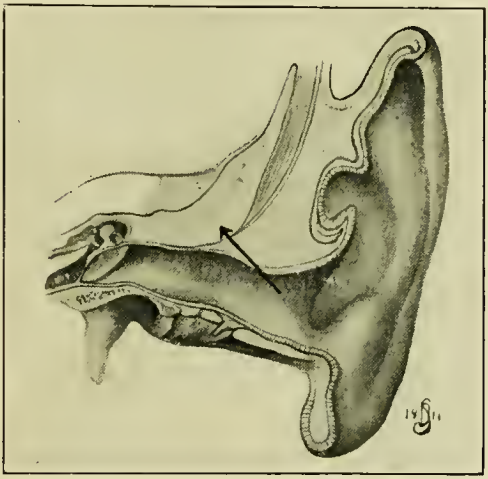


Fig. 14. Neumann's method of anesthetizing the tympanum.

filtrated with a strong syringe. This can usually be done best before the skin is incised and a powerful dental syringe is more satisfactory than the ordinary hypodermic syringe. If there is a considerable degree of osteitis or periosteitis this cannot be done and a liberal infiltration of the skin and the underlying soft parts is all that is possible. Following the injection of the mastoid region, if it is deemed necessary to open the attic, this region must be

especially anesthetized. This may be done by pushing the needle toward the tympanum through the external meatus, thus anesthetizing the skin in that canal. The technic of Neumann may then be followed. This consists in passing the needle at the junction of the fixed and movable parts of the external canal (Fig. 14) and gradually injecting toward the tympanum. In this manner the fluid is made to follow the line of least resistance to the tympanum and results in making the region insensitive.

**Technic of Operation**

The operation may now be proceeded with by making the preliminary incision along the first line of infiltration through the periosteum if this structure has already been infiltrated or down to it if this has not already been done. In the latter case a subperiosteal infiltration must be made. The periosteum is lifted freely from the bone so as to expose the entire mastoid process, and especially the zygomatic ridge, the tip of the mastoid and the bony wall of the auditory canal. Because of the adrenalin the hemorrhage will be found strikingly less than when operating under general anesthesia. The bone itself may now be opened perfectly with a chisel. If the instrument is sharp, the mallet not too heavy and the operator takes the care to make small chips at an oblique angle the sense of jarring will not be unpleasant to the patient. When the cells are reached and pus is discovered the accessible loose cells may be curetted and the operation terminated, if it is one of emergency, or the radical operation may be completed. For this many operators prefer a burr driven by a motor, but it can be done quite as satisfactorily with a chisel if the operator is familiar with the anatomy of the region and is skillful in the use of this instrument. It is necessary to remember the

position of the facial nerve, which lies beneath an easily recognizable ridge of bone. It is rarely necessary to venture too close to this region in order to secure a cure. The sigmoid sinus should be avoided posteriorly; even if the bone covering this sinus is inadvertently removed the sinus will be at once recognized by its blue black color. If doubt exists a touch with the probe will differentiate it from an inflamed cell. Should the sinus be opened it may be packed and the operation proceeded with. The attic may be opened by the gradual removal of the bone upward following the bony ridge and keeping below the zygomatic ridge. Dead bone, if any is present, and granulations may be removed and the ossicles may be extricated if necessary. In some instances in which there is much necrotic tissue there may be some sensitiveness in the attic. This may be relieved by packing with 4% cocain-adrenalin solution. When the operation is completed the wound is loosely packed and the skin incision partly closed.

## CHAPTER VIII

### Operations on the Mouth, Jaws and Neck

Operations in these regions require a knowledge of neural anatomy since the technic, while usually local, often involves nerve blocking. In many instances both methods are combined with advantage. These regions are all supplied by the fifth nerve, but the arrangement of its branches is so complicated that it seems desirable to discuss separately the upper jaw, the lower jaw and the tongue.

Nerve Supply

The upper jaw.—(Fig. 15.) The upper jaw is supplied by the second branch of the fifth nerve. After its course from the Gasserian ganglion into the pterygo-palatine fossa it gives off the spheno-palatine and the superior alveolar branches and continuing in the infraorbital canal escapes from the infraorbital foramen as the infraorbital nerve.

The spheno-palatine branch traverses the palatine canal. One portion escapes to supply the mucous membrane of the palate (Fig. 16). Another portion continuing along the floor passes through the foramen incisivum to supply the mucous membrane of the anterior portion of the hard palate and gums.

The superior alveolar branches are given off from the infraorbital posterior to and within the canal. They traverse the superior maxilla and supply the teeth of the upper jaw after freely anastomosing with one another.

The infraorbital divides into branches which supply the skin of the face, the buccal mucous mem-

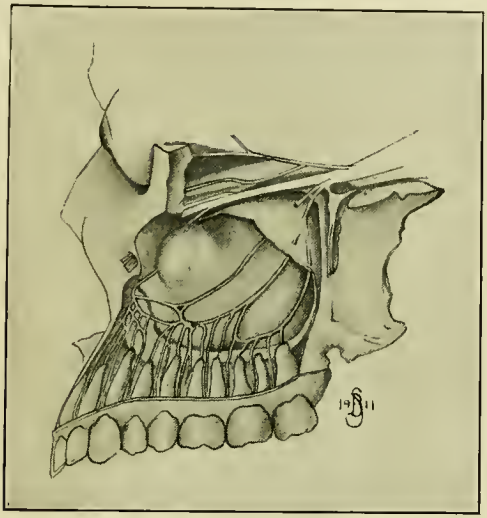


Fig 15. Nerve supply of the upper jaw, external surface. (Modified from Toldt.)

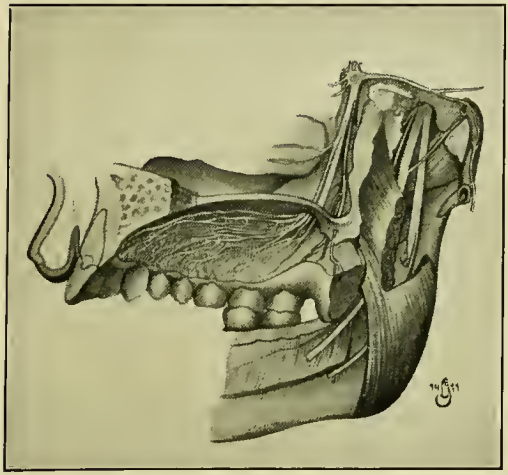


Fig. 16. Nerve supply of upper jaw, palatal surface. (Modified from Toldt.)

brane and the incisor and canine teeth as well as the floor of the nose.

THE LOWER JAW.—(Fig. 17.) The lower jaw is supplied by the third branch of the fifth nerve. Originating in the Gasserian ganglion it escapes from the cranial cavity through the foramen ovale and divides into a motor portion supplying the muscles of mastication and a sensory portion. The latter, which is of interest in this connection, divides into the auriculo-temporal, the lingual and the inferior alveolar branches, the last of which supplies the lower jaw. It descends in front of the internal pterygoid muscle to enter the mandibular canal, which it traverses, giving off branches which supply the gums and lip. The mucous membrane on the lingual surface receives a branch from the lingual nerve.

Nerve Supply

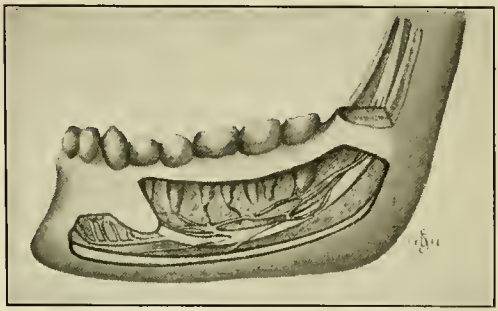


Fig. 17. Nerve supply of the lower jaw. (Modified from Toldt.)

THE TONGUE.—The tongue is supplied by the lingual nerve. It descends slightly in front and internal to the inferior alveolar nerve and enters the tongue opposite the third molar tooth.

Nerve Supply

Anesthesia in this region may be secured by three methods: (1) Submucous infiltration. (2) Subperiosteal infiltration. (3) Nerve blocking.

Submucous infiltration is adapted to operations upon the mucous membrane, such as simple incisions or the removal of tumors.

Subperiosteal infiltration is indicated for operations on the bone itself and particularly for the extraction of teeth.

Nerve blocking is indicated for the extraction of a large number of teeth or for surgical operations of some magnitude. This method requires considerable technical skill.

OPERATIONS ON THE BUCCAL SOFT PARTS.—Small tumors sometimes require removal. Ulcerous processes may require excision, and inflammatory lesions may need to be incised. Simple mucous membrane infiltration secures satisfactory results in such cases.

THE EXTRACTION OF TEETH.—In the extraction of teeth a complicated problem presents itself. The gums surrounding the teeth are sensitive and come into contact with the instruments of the operator. The separation of the tooth in its socket is another source of pain. The chief pain, however, is probably caused by the rupture of the nerve entering the root of the tooth.

Anesthetization of the Gums

Anesthetization of the gum may be readily accomplished by submucous injection, notwithstanding its denseness and sensitiveness. The pain of the initial prick may be lessened by the application of cocain, 5 per cent., or novocain, on a pledget of cotton for a few minutes, or the carbol-menthol-cocain mixture of Bovain may be used.

Following this or without it the needle is entered

obliquely. The point of entrance should be over the alveolar border of the bone (Fig. 18) and not at the free edge of the gum. This makes it possible to anesthetize by diffusion the free edge of the gum which comes in contact with the instruments and has the additional advantage that the periosteum about the roots of the teeth is more readily reached.

Special Syringe Required

A special syringe is required for the purpose since the pressure required is greater than can be secured with an ordinary syringe. The needle is entered just beneath the mucous membrane and a few drops of the fluid are injected. The needle should be passed so that the beveled edge of the point faces toward the bone (Fig. 19). The needle is then made to penetrate the periosteum and the solution is deposited under pressure. Some recommend that the fluid be deposited upon the periosteum allowing it to reach the nerve by diffusion. There can be no question, however, but that subperiosteal infiltration gives more prompt and certain results.

Direction of Passing Needle

In general it may be said that the needle should be introduced where the bone is smooth so that the needle passes readily between the bone and periosteum.

Time is Required for Diffusion of the Anesthetic

The technic must be made to vary somewhat with the region operated because of the varying thickness of the bone and consequently the readiness with which the fluid will reach the nerves.

THE UPPER JAW.—For the molars the injection may be made in a diagonal direction from below upwards. The canine and incisors are best reached by passing the needle parallel with the root of the teeth ending the injection well beyond the termination of the root (Fig. 20) in order that the nerve may be reached by diffusion before it enters the

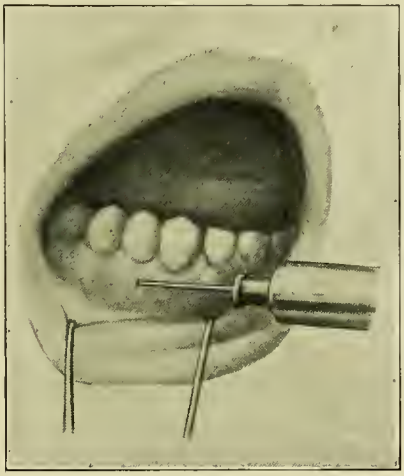


Fig. 18. Point of injection for the premolar teeth.

Fig. 19. Showing the relation of the beveled edge of the needle to bone surface.

Fig. 20. Direction of the needle in anesthetization of the upper teeth.

tooth. The palatal surface, because of its density offers greater resistance to the needle and more care is required to prevent a too hasty injection. The needle is made to enter the mucous membrane just above the tip and is passed beneath the periosteum to above the end of the root. Particular attention should be given to the anterior palatine and incisive foramina when preparing for operation upon the adjacent teeth.

Fig. 21. Anesthetization of the lower teeth.

THE LOWER JAW.—Because of the density of the bone subperiosteal infiltration is less successful in the lower than in the upper jaw. The injection is made into the angle between the tooth and alveolar process (Fig. 21). Here 10 or 15 drops are deposited under as strong pressure as possible. Because of the accessibility of the lingual and mental nerves, blocking is often advisable.

The jaws and tongue, being supplied by nerve trunks which maintain definite anatomic relations to fixed points, are interesting objects for nerve block-

ing. The inferior alveolar nerve offers the most promising results. The lingula, which is usually easily palpable through the mouth, marks the entrance of the nerve into the bone and indicates its most accessible portion. The injection is made at a point $^1/_2$ inch above the surface of the molar teeth and the needle should penetrate slightly more than $^1/_2$ inch and less than $^3/_4$ inch beyond the anterior

Nerve Blocking
Ideal Method

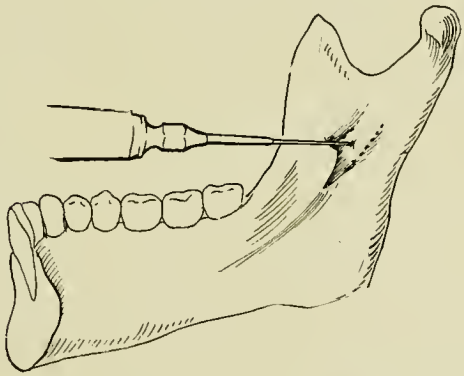


Fig. 22. Point for blocking inferior alveolar nerve.

border of the ascending ramus (Fig. 22). This point may best be located by placing the index finger of the left hand behind the last molar and by resting the tip on the internal oblique line. By passing the needle through the mucous membrane just above the finger and penetrating $^1/_2$ to $^3/_4$ inches in depth the nerve will be reached. It has been well emphasized by Fischer that owing to the obliquity of the ascending ramus the needle must be passed not in the line of the teeth but from the canine tooth of the opposite side. Passed in this line the needle tip comes to lie in the vicinity of the nerve. An in-

jection amounting to 2 cubic centimeters should be made at this point. By injecting a few minims as soon as the needle has penetrated the mucous membrane and depositing a few drops from time to time the entrance of the needle can be made painless. If this technic is properly carried out anesthesia will be complete in about 20 minutes. All the teeth as far as and including the premolars are anesthetized. In order to reach the teeth beyond this point toward the median line the nerve must be blocked at the mental foramen of the opposite side. The mental foramen lies at the base of the alveolar process beneath the first and second premolar teeth. To reach the second premolar tooth the injection should be made above it between the buccal and gingival mucous membrane.

UPPER JAW.—In the upper jaw, the posterior alveolar and the infraorbital nerves are accessible for blocking.

These nerves enter the alveolar process and supply the three molars. They may be blocked by introducing the needle at the fold of the buccal and alveolar mucous membrane above the second molar and passing it along the bone for about an inch. One or two cubic centimeters of fluid should be deposited here. In addition to this, Fischer recommends a submucous injection in front of the first molar and likewise an injection over the posterior palatine foramen. This should anesthetize the upper molar teeth.

The anterior alveolar nerves are given off from the infraorbital just before it escapes from the canal. The fluid should be deposited at the foramen, which is usually $^1/_4$ inch from the orbital border over the first premolar. The needle is entered at

the point where the mucous membrane of the lip curves to the gingival surface. By raising the lip the needle can be made to approach the foramen at an angle. One cubic centimeter of fluid is deposited under as much pressure as possible. In addition the nerves at the incisive foramen must be injected. If the operation is to approach the median line the opposite side should be injected in like manner. Instead of injecting the infraorbital foramen from the buccal surface it may be reached more directly by penetrating the skin directly over the foramen, and introducing the needle $^1/_4$ inch into the canal. By this means the nerves are more certainly reached. The injury to the skin made by the needle is negligible.

Anesthetic of Choice

The anesthetics of choice for this region are novocain and quinine; the former for brief operations, the latter for operations of magnitude, such as the resection of the alveolar process.

By means of nerve blocking as above described anesthesia sufficient for the performance of major operations may be obtained. The most frequent indication will be the removal of epulides and necrotic processes in the mandible. Braun regards local anesthesia as the method of choice for resection of the maxillæ.

### Operations on the Neck

Limitation of Local Anesthesia

Skin lesions of the neck may of course be handled as readily as such lesions elsewhere. Deeper growths may be attacked if they are fully encapsulated. Lipomas and cysts of the neck may be removed. The removal of lymph glands should be attempted only after careful consideration. Usually one which seems on examination to be solitary and movable is likely to be found on exposure not freely movable

and but one of a chain. Lymph glands are rarely proper objects for attack unless one is to be removed for diagnostic purposes. Branchial cysts being deeply attached require much care in the deep infiltration. Though the neck is supplied by nerves of definite distribution infiltration about the periphery of an area to be removed is always resorted to. If a growth is well encapsulated, a thorough edematization aids materially in its removal.

THYROIDECTOMY.—The thyroid gland is frequently removed under local anesthesia. The skin and subcutaneous tissue together with the platysma are infiltrated in the line of a collar incision and the infiltrated tissues incised. The gland is then infiltrated about its entire periphery, particularly at the upper pole and about the isthmus. In this manner the operation proceeds painlessly until it comes to the dislocation of the lobe, which is usually painful. Many operators prefer to give a few whiffs of chloroform at this stage. A more thorough infiltration beneath the lobe and particularly about the upper pole will do much to prevent this pain.

Do Your First Operation Under Ether

TRACHEOTOMY.—This operation can be done with the greatest satisfaction under local anesthesia. A line in the skin and subcutaneous tissue is infiltrated from the middle of the thyroid cartilage two inches downward. The incision is then made down to the cartilaginous rings. There are usually a number of veins requiring ligation, which, if the operation is done at leisure, should be tied before the rings are cut. If there is urgency they are clamped and the cartilages cut and a tube placed; ligation may then be done at leisure. The crico-thyroid artery is usually exposed at the upper end of the incision and if seen should be ligated and cut. The thyroid isth-

Fix the Trachea with Tenacula before Incising It

mus is retracted downwards and the first and second tracheal cartilages incised. It is well to make anchor sutures about the rings before they are severed so that retraction may be made upon them and the incised edges held apart.

OPERATIONS ON THE FLOOR OF THE MOUTH.—Blocking the lingual nerve has not given satisfactory results though it can be easily reached at the angle of the jaw. Infiltration of tissue is to be preferred. Benign tumors only are to be attacked under local anesthesia. Benign lesions of the anterior part of the tongue may be satisfactorily attacked but local anesthesia finds its most frequent application in the cysts in the floor of the mouth. For these, infiltration about the tumor gives satisfactory results.

# CHAPTER IX

## Operations on the Tonsils, Adenoids and Uvula

OPERATIONS ON THE TONSILS.—The tonsil is one of the important organs of the body from the pathological point of view. Because it rarely directly endangers the life of the patient no disease is so often neglected as tonsillar affections. Though the need for treatment may be recognized by the general practitioner, the condition is often neglected because a specialist is not accessible and the general practitioner does not feel competent to manage it. The timidity on the part of the general man is due in great part to exaggeration by specialists of the seriousness of the operation. Compared to the application of the forceps or version in obstetrical practice, operations upon the tonsil are safe and simple. The attempt in the following account will be to present the problem in its simplest form. While recognizing the dangers they will be presented in the light of the general operator, not possessed of the skill of the specialist. This is done in the belief that, short of the elegance of the specialist, much useful service can be rendered by the general man possessed of ordinary manual skill.

PERITONSILLAR ABSCESS.—Infections of the tonsil are not infrequently followed by the formation of abscesses in the loose cellular tissue external to and above the capsule of the tonsil. The bulging of the tonsil and the redness and edema of the pillar give a hint as to the location of the abscess.

Topical Application Most Effective

Because of the inflamed tissue injection anesthesia is unsatisfactory. A satisfactory degree of anesthesia may be obtained by the application of the cocain and carbolic mixture over the pillar about midway up the tonsil. An incision is made $^1/_3$ inch from the edge of the pillar so as to avoid the palatine artery which runs just within the edge of the pillar. The incision should be $^1/_2$ inch in length and $^3/_4$ inch deep. The bistoury may be armed with a shoulder of adhesive plaster to prevent the knife entering too deeply.

If the abscess is well formed pus flows freely. If at an earlier stage, a closed forceps may be passed, then opened and withdrawn. This causes momentary pain, but the immediate relief causes the patient to forget the pain in the joy of the after effects. Gargling with hot water hastens the relief.

Anomalies in Circulation

TONSILLECTOMY.—The blood supply of the tonsil is derived chiefly from the ascending pharyngeal artery. The nerves are derived from the hypoglossal and enter the tonsil from below; other branches are said to enter from above.

Anesthetic of Choice

Anesthetization. Many operators employ cocain and adrenalin. Ballenger employs a 4 per cent. cocain in 1:2000 adrenalin solution. Cocain in this strength must always be employed with some apprehension by the inexperienced. Far superior in my opinion is quinine, which has the advantage of efficiency and perfect safety. Any amount of the solution may be used without fear of intoxication. The principle here is the same as in the removal of tumors. An edema of the peritonsillar tissue should be produced, which not only secures perfect anesthesia, but also by the loosening of the capsule facilitates removal. A cubic centimeter may be in-

jected into the peritonsillar tissue at the points figured in the cut (Fig. 23). The lower portion should be infiltrated with especial care. The posterior pillar likewise requires consideration, for if a short needle be used it reaches just beneath the anterior pillar and unless a large amount of fluid be

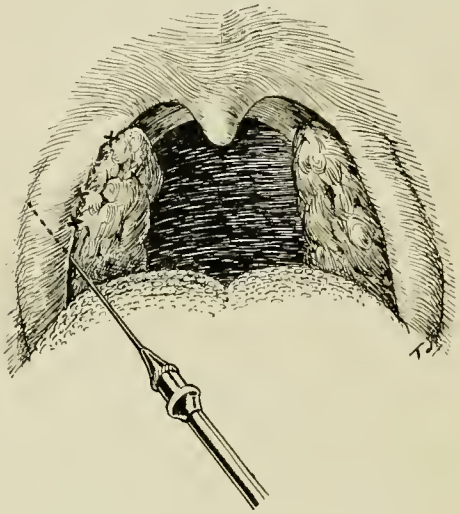


Fig. 23. Injection of peritonsillar tissue.

used here the posterior pillar will be uninfluenced. A larger needle will much facilitate the injection. It is convenient to infiltrate first one tonsil thoroughly and then the other. By the time the second side is injected the first will be anesthetized and may be removed. By the time the first side is removed and the hemorrhage controlled the second side will be ready for removal. The question of hemorrhage is always a vital one. Adrenalin lessens the amount of bleeding at the time of the operation, but this ad-

vantage is often purchased at the expense of a persistent oozing after the operation. Cocain-adrenalin gives the maximum hemostasis at the time of operation but the greatest likelihood of later hemorrhage. Quinine gives a preliminary hyperemia and a later hemostasis much reducing the likelihood of after-hemorrhage. To secure early hemostasis with quinine, adrenalin may be added, but by doing so its hemostatic effect after operation is sacrificed. The choice will then depend upon the operator, the place of operation and the kind of after-care the patient will receive.

TOTAL REMOVAL.—The operation now most generally practised is the removal of the entire tonsil together with its capsule. This is the operation of choice in all cases in which there are chronic changes produced by the enlarged tonsil in other portions of the throat and if there have been repeated peritonsillar abscesses. These include the majority of cases beyond puberty and more particularly those in later life.

Many plans have been proposed for the performance of this operation and a large number of instruments devised. Either a scissors or knife may be employed and a suitable forceps for the fixation of the tonsil is required.

Technic of Operation

The tonsil is grasped with the forceps and traction made downward and forward. With knife (Fig. 24) or scissors the anterior pillar is separated from the tonsil. The incision is continued over the summit of the tonsil to the posterior pillar. If desired the finger may be used to loosen the tonsil after the preliminary incision is made. In some instances the tonsil is very readily dislocated, while in those (usually adults) in which repeated peri-

tonsillar abscesses have preceded sharp dissection may be required. After the tonsil has been dislocated and hangs merely by a pedicle at the inferior border this may be separated by scissors or knife or by some of the special apparatus (snare [Fig. 25] or loop) made for this purpose.

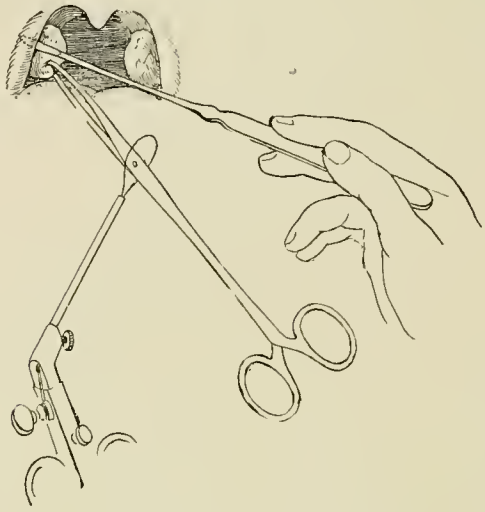


Fig. 24. Separation of tonsil from anterior pillar.

Control of Hemorrhage

The control of hemorrhage is usually a simple matter. By pressing a pledget of cotton against the place vacated by the tonsil, hemorrhage usually ceases promptly. If the hemorrhage is more serious it is better to seize the bleeding point and squeeze it. If the operator is observant he will have no difficulty in determining at which point the vessel was cut. Ballenger recommends the use of $^1/_8$ to 1 gr. potassium permanganate to an ounce of water for use with a tampon. Large clamps recommended for

the control of hemorrhage are less easily manipulated than a forceps armed with a wad of cotton. The after treatment consists of a mouth wash and liquid diet.

After Treatment

Whether this operation should be performed in a hospital or not depends upon circumstances. The hospital is more convenient, but many people require

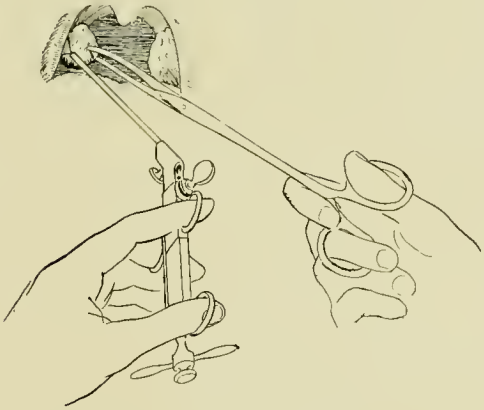


Fig. 25. Removal of tonsil by snare.

the operation who will not go to a hospital and many practitioners should perform the operation who do not have access to a hospital. Frequently the operation can be done with satisfaction in the home, especially with the use of quinine as an anesthetic which prevents the oozing hemorrhage so common after cocain and adrenalin. I have never yet seen a misfortune come from treating such patients of all ages at home.

PARTIAL TONSILLECTOMY.—The tonsillotome formerly universally used is still capable of useful service. In children with enlarged tonsils and

adenoids the use of the tonsillotome followed by the removal of the adenoids gives satisfactory results. The Fahnstock instrument is the handiest, while those without the hook (Casselberry's) in which traction is made with a tenaculum held in the other hand is the more efficient in experienced hands. As much as possible of the tonsil is removed with the tonsillotome. This is sufficient in many instances. The remainder may be removed with the Ruault punch by which practically a complete removal is secured. This operation is the simplest to perform and the beginner will do well to employ it in his first attempts. Anesthesia is the same and the hemorrhage never so severe as to cause alarm.

Anatomic Exploration of Hemorrhage

ACCIDENTS IN TONSILLECTOMY.—The chief accident feared is hemorrhage, and much has been written about it; but few instances have been recorded where fatal hemorrhage occurred. Many hypotheses have been offered to explain the accidents. The carotid artery has not likely been wounded. The single anatomical anomaly which would make a really serious hemorrhage possible is a high arching of the facial artery (Waldeyer). The usual source of alarming hemorrhage is an unusually large tonsillar artery or a branch of the palatine artery. It is rare that a vessel large enough to make a whistling noise is cut; if this occurs it can be controlled by ligation. Late bleeding is more to be feared than bleeding at the time of operation because blood may escape down the patient's throat quite unobserved. This sometimes occurs after a number of days have passed. It is this danger that makes hospital treatment for these patients desirable. The effect of quinine upon the tissue is such as to preclude the possibility of late hemorrhage.

Instruments Used

Infection through the tonsillar wound may be the source of mischief. This accident is more to be feared than hemorrhage because there is always the possibility of serious mischief and unlike hemorrhage it may occur despite every precaution.

ADENECTOMY.—The removal of adenoids is indicated more often than any other operation in surgery and it is likewise the safest and simplest. Thirty thousand were performed in Lucae's clinic without a mishap.

Method of Anesthetization

Adenoids are situated in the vault of the pharynx, between the tubal ostia on each side, with the vomer in front and the vertebræ behind. No direct nerve nor vascular supply can de defined and in fact an identification of these is not needed.

Anatomy

It is difficult to anesthetize this region. Sprays into the vault of the pharynx or application on a carrier may be employed but application through the nares is most usually done. Carriers armed with cotton are carried through the nose to the vault of the pharynx, and are frequently renewed until anesthesia is obtained. This operation is most often needed in childhood, when any type of anesthesia is difficult. The operation requires but a moment and is not painful and is well borne. General anesthesia may be employed but is vastly more dangerous than the operation itself, because of the possibility of blood aspiration—an accident not certainly obviated even by operating in the hanging head. I prefer always to operate with local anesthesia or with no anesthesia at all. The operation may be divided into three very definite steps:

1. The adenoid curet is grasped pen-like or with the full hand, depending on the density of growth. The pen-hold is best in young children

with soft growths because it permits the easiest manipulation and gives force enough to remove the growth. The scalpel hold is preferable for growths

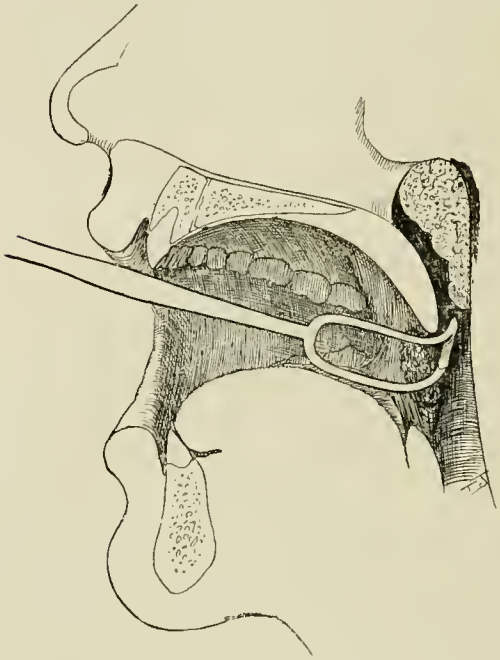


Fig. 26. Introduction of adenoid curet.

of medium density because it gives a firm hold with good movement and the full hand is required in hard dense growths because it gives force enough to insure their removal. The handle of the instrument is lifted so that the point dips under the soft palate (Fig. 26).

2. The handle is sunk so that the tip of the cu-

ret touches the vomer and may then be pushed against it to the summit of the pharynx thus insuring that the curet will reach the interval between adenoid and vomer (Fig. 27).

3. The curet is pushed against the posterior

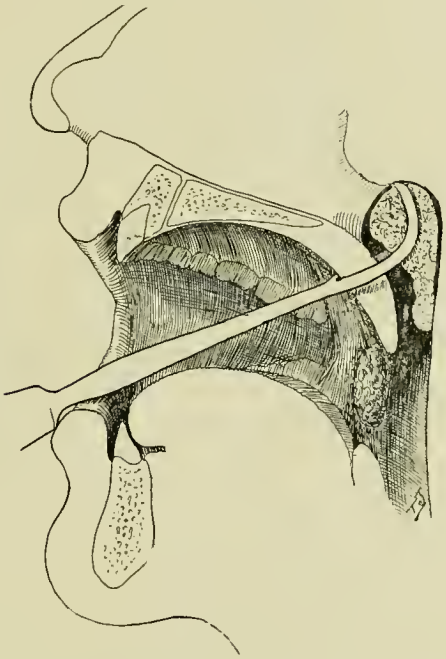


Fig. 27. Position of curet at beginning of downward stroke.

vault of the pharynx and then drawn energetically downward the handle being raised at the same time (Fig. 28).

If the movement is made skillfully, the severed adenoid can usually be thrown out of the mouth of the patient. Sometimes shreds hang behind the palate and must be removed with forceps.

Some operators make one cut in the center and one on each side. Others make but a single cut in the midline. If the curet corresponds in size to the pharynx a single cut is sufficient. If lateral cuts are

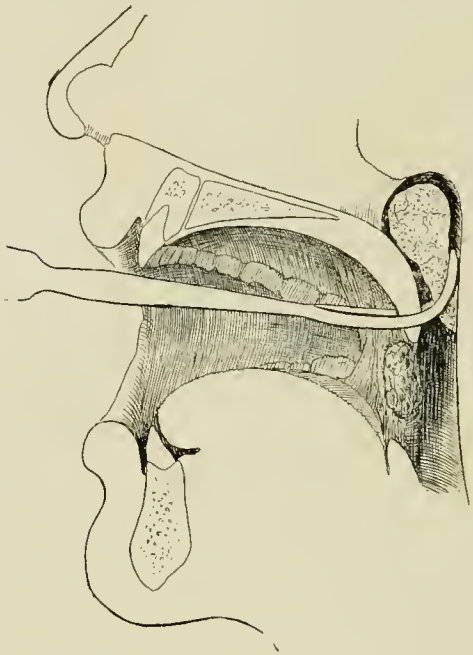


Fig. 28. Removal of adenoid.

made the tubal ostia should be remembered.

Specialists have special instruments and do a more perfect operation. They use lateral cutting forceps and a special curet for the vault. The finger is used to control the instrument. These more perfect operations can be done in adults under local anesthesia, but for children a general anesthesia must

be used. Such operations are indicated especially when there is much ear involvement; but when the

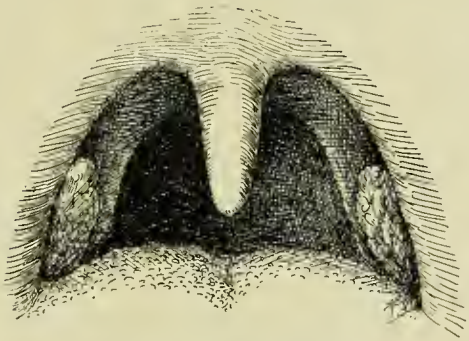


Fig. 29. Elongated uvula.

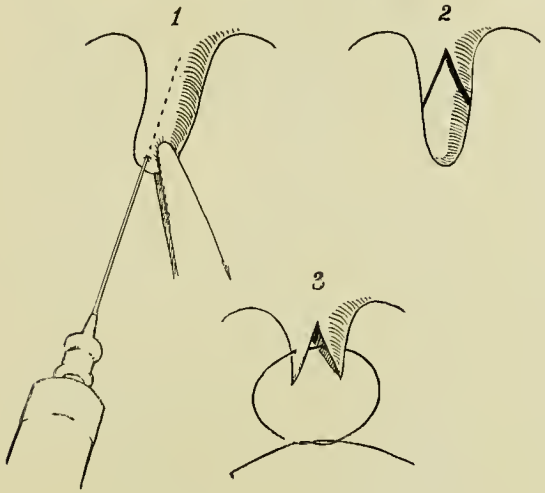



Fig. 30. Removal of redundant uvula. 1. Injection. 2. Incision. 3. Suture.

operation is done early a simple curette operation produces the desired results without the dangers of an anesthetic.

The Object Is to Get the Adenoid

DANGERS OF ADENECTOMY.—There are none. When done under general anesthesia aspiration of blood may take place, but hemorrhage itself is never alarming. If fibroids of the pharynx are removed as adenoids serious hemorrhage may result, but these rare conditions can hardly be mistaken for adenoids.

**Beware of Fibroids of the Pharynx**

After-treatment consists in shielding the patient from exposure to cold to avoid causing an otitis media or lighting up an old one. There may be a slight rise in temperature for a day, but quite as often there is no reaction whatever. Children usually decide the after-treatment for themselves apparently without detriment.

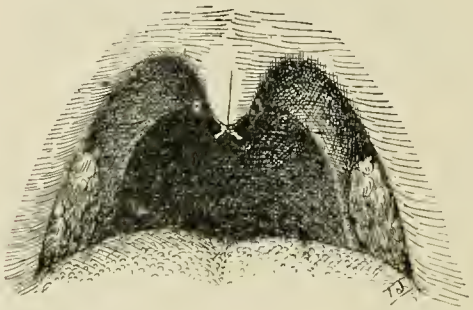


Fig. 31. Uvula after removal of redundant portion.

ELONGATION OF THE UVULA.—The elongated uvula (Fig. 29) is not infrequently the object of operative attack. It is first painted over a number of times with a 2% solution of cocain and then grasped with forceps and an injection made into its substance (Fig. 30). The redundant portion is then removed by a V-shaped incision and the edges coapted. If the proper amount is excised the normal appearance should be restored (Fig. 31).

**Be Sure that it Requires Removal**

# CHAPTER X

## Operations upon the Thorax

Local anesthesia is indicated positively more often in the thorax than anywhere else. In fact the very existence of disease affecting organs in the chest places at once a contra-indication against general anesthesia. The various diseases of the lungs and pleura furnish the most frequent objects for surgical attack, but the circulatory organs also are beginning to receive the attention of surgeons.

Range of Application

Pleural effusions, empyema and lung abscess may all be satisfactorily operated under local anesthesia. It is of interest to note that the disastrous accidents attending operations for these diseases are strangely infrequent when they are done under local anesthesia. It is in exceptional cases only that a general anesthetic is permissible. Decortication and thoraco-plastic operations alone demand a general anesthetic and in these the available lung space has become accustomed, because of the chronicity of the disease, to the performance of the respiratory function and in consequence the use of general anesthesia is less dangerous than in acute conditions in which the respiratory system has not yet reached a balance to the new conditions.

EXPLORATORY PUNCTURE.—The diagnosis of fluid in the pleural cavity is made easily from physical signs alone. In some instances, however, difficulties present themselves and it is advisable always to demonstrate the presence of fluid by exploratory puncture before attempting aspiration.

Be Sure the Needle is Long Enough

An ordinary hypodermic syringe fitted with a standard needle is sufficient if the thoracic wall is thin, but in many cases a longer needle is required. The caliber of the needle is dependent upon the character of the exudate. In fresh exudations a fine needle is satisfactory, but in long standing exudates or purulent effusions a larger bore is required. A syringe capable of being boiled with the needle should be employed, but if such cannot be obtained, the needle should be boiled and the syringe chemically sterilized, preferably with formalin or iodine. The skin may most conveniently be prepared by painting with tincture of iodine or by washing with soap and water followed by alcohol. Many practitioners use no anesthetic in making the puncture; a local anesthetic removes the pain during and after the operation. Freezing effectually prevents pain in the skin from the initial prick, but the effect is evanescent and it is followed by after-pain. Salt and ice pressed against the skin for a minute or two lessens the sensibility to a considerable degree. Neither of these methods produces an anesthesia lasting long enough to permit careful exploration. Injection anesthesia is, therefore, preferable because it not only permits the operator to study the character of tissue through which the needle passes but if therapeutic measures are to follow the operation may proceed at once. Quinine, because of its efficiency and the duration of its effect, is the most suitable substance. Ten or twenty minims of 1 percent. solution is drawn into the syringe, a fold of skin over the intercostal space in which the puncture is to be made is caught up between the thumb and forefinger so that it becomes anemic and thus less sensitive. The needle is made to penetrate the skin at a slight angle

and a few drops of the fluid are deposited in the skin. The needle is then gradually forced inward immediately above the next rib below in order to avoid the intercostal vessels which lie in the groove of the upper rib. As the needle reaches the pleura the resistance is increased or the patient experiences slight pain. The remainder of the anesthetic fluid in the syringe is deposited at this point. An interval of a few seconds permits anesthesia to become effective and the needle may then be pressed into the pleural cavity, whereupon the resistance is suddenly lessened. The syringe is then steadied with the left hand while the right gradually withdraws the piston. If fluid is present it should appear in the barrel of the syringe. If no fluid appears it is either absent or the needle may be too short to enter the thoracic cavity or the fluid may be too thick to pass through the needle. If no fluid is present the needle can be felt to strike the visceral pleura and usually the patient complains of pain. If there is doubt about the needle entering the cavity, a longer one should be employed. If the physical findings for fluid are definite and the case is of long duration the possibility of a fluid too thick to pass the needle must be entertained and a needle of larger calibre employed. Adhesions at the site of puncture may give a negative aspiration. In that event the same procedure must be repeated in other likely situations. If the site of an adhesion is punctured the needle enters the lung, which is manifest by the entrance into the syringe of bubbles of air covered with blood.

THORACENTESIS.—The former practice of awaiting resorption of pleuritic exudates has very properly given place to the removal of the fluid by aspiration. It has been the practice to await urgent symp-

toms or conclusive demonstration of the inability of the system to absorb the fluid before operation was resorted to. It is now becoming generally recognized that the absorption of the fluid even in favorable cases is capable of injury to the patient. The sole objections to the operation are the danger of converting a sterile into a purulent exudate and the discomfort to the patient from the operation—or to the doctor if he be overtimid. All these objections are obviated by the use of local anesthetics.

The correctness of the diagnosis having been demonstrated by exploratory puncture the question of the removal of the fluid must be decided. This may be best undertaken at the time of the exploratory puncture for it saves the patient a second annoyance and the doctor a second preparation. The clinical diagnosis should be sufficiently accurate to determine the character of apparatus which will be required. The exact point where fluid will be obtained is known. A tract for the aspirating needle in case aspiration alone is needed is already anesthetized, the interval between the puncture and the aspiration permitting perfect anesthesia to take place.

Test All Apparatus Before Beginning

In the absence of more suitable apparatus a syringe holding a few drams, and fitted with a stopcock may be employed. It is a slow method and is trying to both patient and operator, but it is possible to remove large accumulations with this simple apparatus. The most suitable apparatus is the Potain aspirator, an instrument which should be in the hands of every practitioner for if he is alert in his diagnoses he will find sufficient use to warrant its purchase. The principle of this apparatus is that of an air pump; it produces a vacuum within the con-

tainer intended to receive the fluid which outbalances the negative pressure of the thorax and thus prevents the formation of pneumothorax. A simpler improvised apparatus (Fig. 32) may be employed. A cork with double perforations is fitted with two glass tubes to which are attached lengths of rubber tubing. To one of these the aspirating needle is

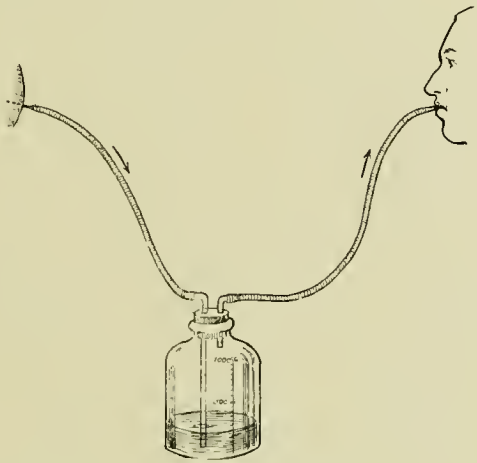


Fig. 32. Improvised aspirator.

attached and the other is employed by the operator to make suction to counterbalance the intra-thoracic pressure of the patient. Whether a needle or trocar shall be used is a matter of personal preference. The trocar, being dull, enters less readily but has the advantage that when the stylet is withdrawn there is no sharp point to injure the expanding lung. The needle on the other hand enters readily and enables the operator to judge the character of the tissue through which it passes, but easily injures the lung.

Careful Asepsis is Required

All apparatus which comes in contact with the patient should be prepared by boiling. The hand of the operator should not touch that portion of the needle which is to enter the tissue. The needle is passed along the tract of the exploratory puncture already anesthetized, and this may be accomplished without pain. If the needle is none too sharp, it is often desirable to nick the skin with a scalpel so as to avoid an annoying degree of pressure. The preliminary use of the scalpel is particularly indicated when a trocar is used. When the parietal pleura is passed aspiration may begin. If a Potain apparatus is employed the cock on the tube leading from the aspirator is opened (the air having been previously pumped from the bottle) and the fluid will trickle into the bottle. When the flow ceases the stopcock on the tube leading from the aspirator is closed, the one leading to the pump is opened and the pump started. When sufficient vacuum has been created within the bottle the cock on the pump-end is closed and the other is opened. The flow will then start again. If the operator is sure his apparatus is working well the pump may be used with both cocks open so that the fluid flows into the bottle as the air is being exhausted by the pump. If the improvised apparatus is employed the operator should make suction upon the tube when the aspirating needle is in position. The pinch cock on this tube should not be released until the tube is in the operator's mouth and suction started, and must be closed each time the operator pauses to renew his breath.

If in Doubt Stop

Whether all the fluid obtainable is to be withdrawn at the first aspiration depends on circumstances. In neglected cases when a considerable amount of fluid is withdrawn, a temporary irritation

indicated by coughing may attend the expansion of the lungs, or the replacement of the heart to its normal position may cause a sense of faintness. Either of these sensations if at all marked should be a signal to the operator to desist. In early cases the first evidence of discomfort is shown when the fluid is nearly all removed and the expanding lung causes the visceral pleura to come in contact with the end of the aspirator. This pain can often be relieved by withdrawing the needle or by tilting the tip downward. When the operation is ended the aspirator is withdrawn and the wound is closed with gauze and collodion or adhesive plaster. If it is necessary to interrupt the aspiration before the fluid is all withdrawn the operation should be repeated after an interval of a few days.

PERMANENT DRAINAGE.—Purulent fluid requires a permanent exit. In children this is satisfactorily accomplished by the introduction of a fair sized (say 26 F) soft rubber catheter through a simple intercostal incision. Sometimes the catheter is pushed through the sleeve of a large trocar, after which the latter is withdrawn. It is often possible to employ this method under local anesthesia in quite young children. It is especially efficient also when permanent suction is to be applied to the drainage tube. Permanent suction has been accomplished in various ways. The simplest method is by the permanent application of a Potain aspirator, the negative pressure in the receiving bottle being kept at the point of easy tolerance.

Do not Forget to Boil the Drainage Tube

RIB RESECTION.—In empyema, the resection of a rib is necessary, except in children, in order to secure satisfactory drainage. The diagnosis is less certain than in case of serous effusion by physical

means alone. Before operation it is always advisable to verify the diagnosis by puncture.

The resection of a rib is a simple operation but

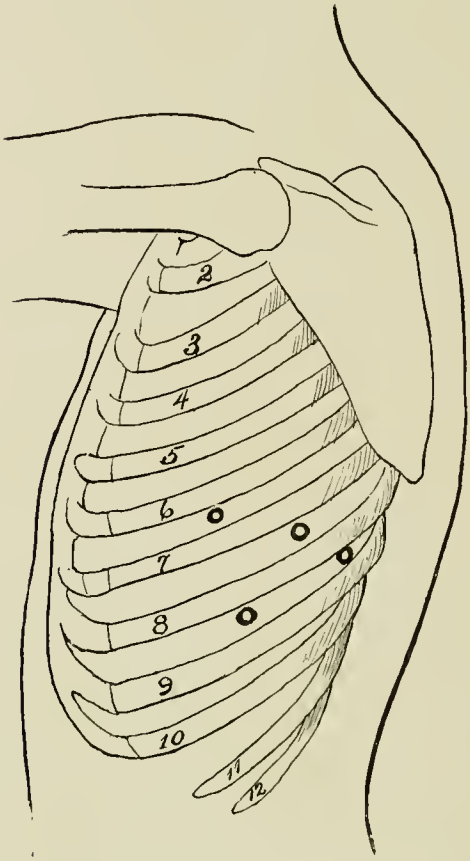



Fig. 33. Sites of election for thoracentesis.

since it is always done upon a dyspneic patient, the complications are often annoying. Instruments sufficient to meet all possible emergencies should always

be at hand. Aside from the usual syringe and solution for local anesthesia, a rib shears or a bone cutting forceps, a periosteal elevator, knife, scissors and a number of hemostats and a needle threaded with catgut should be provided. The latter may be needed should the intercostal vessels be inadvertently severed.

The site of operation is selected, usually the 7th or 8th rib at the mid-axillary line (Fig. 33) and an area of skin disinfected either by iodine or soap and water.

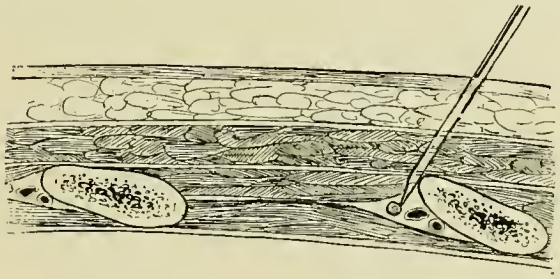


Fig. 34. Infiltration about intercostal nerve.

A line of skin 3 inches long is injected over and parallel with the rib selected for removal. The area immediately beneath the rib at both ends of the line of injection is infiltrated in such a manner as to deposit a pool of fluid about the intercostal nerve (Fig. 34). Next the periosteum over the rib is freely injected. If the operator is not experienced in the use of local anesthetics it is better to wait until the periosteum is exposed before injecting it. A wait of a few minutes permits anesthesia to take place. An incision is made through the skin the length of the line infiltrated. The muscle over the rib is next incised. All hemorrhage should be controlled at

this point. If the pleura was not injected at the time of the initial infiltration this is now done by passing the needle between the periosteum and rib. The periosteum over the rib is then incised for a distance of two inches (Fig. 35). The periosteum is elevated from the rib about its entire circumference, care being taken to remove it from the groove containing the intercostal vessels (Fig. 36). The pleural surface of the periosteum must not be perforated. The periosteum being loosened for the entire distance of the incision, the rib may be cut. At least an inch should be removed. The opening thus made has for its floor the visceral periosteum. If the periosteal vessels have been cut they may be controlled by mass ligatures through the muscle When all hemorrhage has been checked the drainage tubes are made ready, the periosteum is quickly incised (Fig. 37) and the tubes passed into the opening. The tubes must be sutured to the skin in order to prevent their slipping into the thorax. Many operators permit the pus to flow out before a dressing is applied, others prefer to apply a large snug dressing quickly and permit the pus gradually to soak into it.

If the visceral periosteum is inadvertently opened the pus flows at once and the cutting of the rib and the control of any hemorrhage that may ensue must be done in a puddle of pus.

**Drainage Should not be Removed Too Early**

The duration of the quinine anesthesia is such that nothing is required for post-operative pain. The dressings must be removed as they become soiled. After the flow has lessened the tubes are gradually shortened and can usually be removed in from 2 to 6 weeks, depending on the nature of the infection, the earlier period if the pneumococcus or

influenza bacillus is the infective agent, the longer if the empyema is secondary to some infection of the abdomen or pelvis.

DRAINAGE OF LUNG ABSCESSES.—The exact situa-

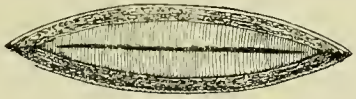


Fig. 35. Resection of rib. Incision of external periosteum.

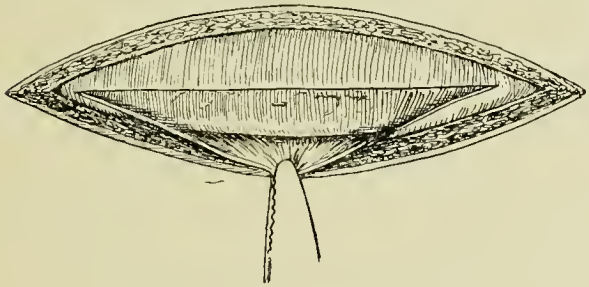


Fig. 36. Resection of rib. Elevation of periosteum.

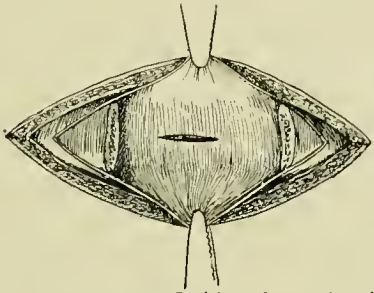


Fig. 37. Resection of rib. Incision of pleural periosteum.

tion of abscesses of the lung is difficult to find, but they are easily drained. Physical examination can usually indicate their presence with a considerable degree of certainty; but it is only by aspiration that their presence and exact location can be determined.

Location of the Abscess

The technic of exploratory puncture is not unlike that of exploration of the pleural cavity except that a longer needle is required and that the search is more prolonged and much more difficult. Physical examination must locate the lesion approximately and the point of the needle must be made to enter the suspected region. The density of the tissue which the needle penetrates can usually be perceived and often when the cavity is a considerable one the entrance of the needle into it is felt. Whenever resistance to the advancing needle suddenly ceases after passing through comparatively dense tissue the piston of the syringe should be withdrawn in order to determine if pus has been reached. Often numerous punctures must be made at the same or at several sittings before the nidus of infection can be located. The needle must be removed at each change of direction. Usually withdrawing it until the point is just within the visceral pleura will permit the desired change of direction.

When the pus is located, the exploring needle should be left *in situ* and a rib resected as explained above. When the pleura has been opened the needle may be followed by a closed artery forceps in order to secure an opening large enough to admit a drain. Better still is the instrument devised by me for this purpose. The needle is straddled with the instrument (Fig. 38) which is then forced through the lung until its tip enters the abscess. The blades are then separated, the needle withdrawn and a drainage tube substituted and the instrument withdrawn This permits the tube to be introduced more quickly than if the dilatation is made with forceps.

If the pleural space is not obliterated by the adhesions of the parietal and visceral pleura the area

must be packed for a few days until obliteration does take place. It is often possible to determine if the visceral and parietal pleura are adherent by the sensation imparted to the needle when it is passing from the one to the other. If there are no adhesions the movement of the lung will be felt by the tug upon the needle. This method is by no means a certain test and it is only after a rib has been resected and the pleura opened that any reliable information is obtainable. If the pleural space is obliterated the abscess is drained at once. If there is a free space

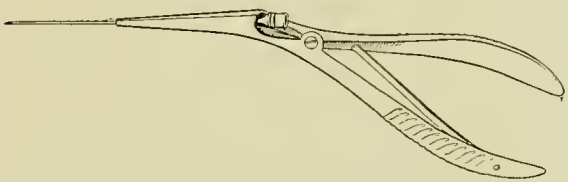


Fig. 38. Author's instrument for introducing drain into lung.

the opening in the parietal pleura is packed with plain gauze in such a manner that it comes in contact with the visceral pleura thus exciting adhesions. Reliable adhesions will have formed in 3 or 4 days. The method of obliterating the space by suture is not suited to local anesthesia and is objectionable because immediate suture does not certainly protect the pleural cavity from infection if the abscess be drained at once.

The opening of lung abscesses following pneumonia offers no difficulties under local anesthesia. Those following prolonged suppurative processes in the pelvis or abdomen in which the patient is often pus soaked for many months and usually more

or less accustomed to the use of morphine are not favorable cases for local anesthesia. Unless the operator is experienced both in the treatment of lung abscesses and in thoracic operations under local anesthesia he will do better to place the additional burden of a general anesthetic upon the patient.

## CHAPTER XI

### Abdominal Operations Under Local Anesthesia

INDICATIONS.—Local anesthesia is employed for laparotomies under special conditions, either because no anesthetic is at hand or because there is some pointed contra-indication to general anesthesia.

PALLIATIVE OPERATIONS.—Malignant disease offers the most frequent indication for local anesthesia. The patient, already much reduced by the disease, is endangered both by the general anesthetic and the prolonged recumbency necessary when a general anesthetic is used. Palliative operations are most often demanded by neoplasms which occlude the intestinal canal. Gastrostomy, gastroenterostomy and colostomy are the procedures usually demanded. Abscess formation from any cause presents frequent opportunities for local anesthesia, particularly those following appendicitis and pelvic infection.

EXPLORATORY OPERATIONS.—Diagnostic incisions under local anesthesia are indicated only when it is probable either that no operation will be possible or that it will be palliative only. The radical operation for abdominal disease, particularly when neoplastic, makes a general anesthetic desirable. If a radical operation is found to be possible after exploration the general anesthetic may be resorted to. In those cases in which a palliative operation is not indicated and it is probable that a radical operation is not possible a confirmatory incision under local anesthesia may be satisfying to the patient and a source of information to the surgeon.

NEURAL ANATOMY OF THE ABDOMINAL ORGANS.—(Fig. 39). The skin of the abdomen is supplied in the upper portion by the seventh to the twelfth intercostal nerves and below by analogous posterior root nerves, especially the ilio-hypogastric. These nerves travel at first between the layers of the abdominal muscles and at the border of the rectus muscle pierce the fascia and are distributed to the skin. Other filaments pass backward and end in the subperitoneal connective tissue. The viscera and the visceral peritoneum are supplied by the sympathetic system. Two plexuses supply the gastro-intestinal canal; Meissner's, a fine meshed plexus beneath the submucosa, and Auerbach's, a larger meshed plexus between the muscular layers. These form a complete web about the gut. Filaments from them can be traced to the mucosa. On the contrary the peritoneum, properly speaking, is devoid of nerves. The solid abdominal organs are supplied likewise by the sympathetic system, but this has no practical bearing in anesthesia.

Much discussion has arisen as to the presence or absence of sensibility of the abdominal organs. The divergence of opinion is due largely to the fact that the anatomy of the nerves supplying these regions is not taken into account. In experimental studies, the stimuli have been varied in kind, and observations have been made under conditions which have not been kept uniform. The presence or absence of inflammation has not been considered and the fact that the kind and stage of inflammation has an important bearing has been almost wholly ignored.

Much useful information as to abdominal sensibility has been gained, notably by Lennander. In general the rule holds good that if nerves are sub-

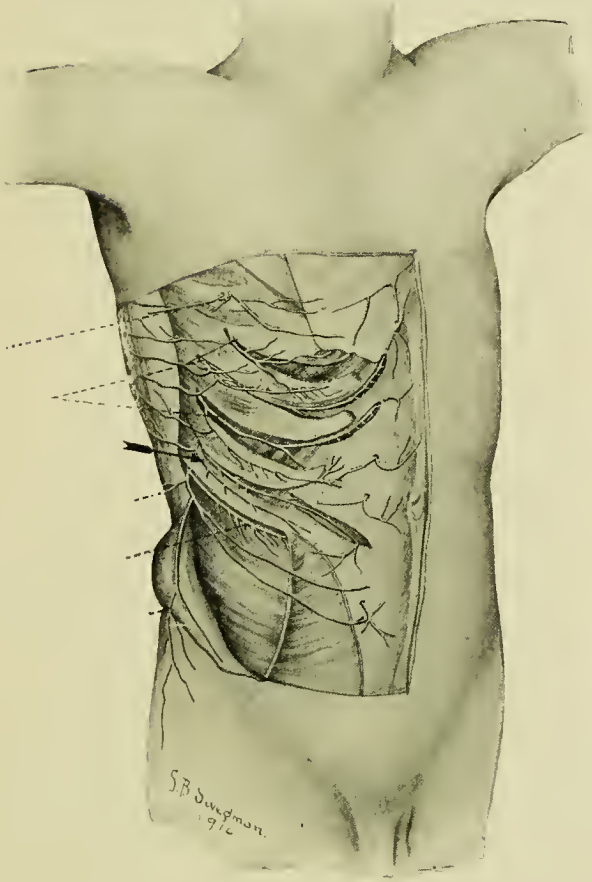


Fig. 39. Nerve supply of the abdomen. (Redrawn from Toldt.)

jected to unaccustomed mechanical or chemical influences pain is caused. The parietal peritoneum is most abundantly innervated and is notoriously painful for this very reason. Cutting and crushing is painful for it is impossible to pick up a fold of this structure or to cut it without injuring a nerve. Cutting separates the nerves in continuity and the pain is not so exquisite as when end organs are injured since the terminal filaments only are sensitive.

The gastro-intestinal tract is supplied by a network of nerves which, in comparison with the size of the nerve trunks, is very extensive. These nerves are subject to varying pressures as the intra-abdominal pressure changes with the tension of the muscle; and if by manipulations these usual values are not exceeded, abdominal viscera may be handled without pain. The range of pressures, however, within which no pain is caused, is rather narrow. A direct prick is not likely to cause pain because the needle point is more likely to pass between the nerve filaments than to strike one. A superficial prick especially is less likely to cause pain because the superficial plexus is wider meshed than the deeper one.

**Traction is the Chief Cause of Pain**

Organs with walls sufficiently rigid to withstand pressure may be handled with less pain than those which yield to it. Thus the rigid stomach may be pulled upon with greater force than the more flaccid small intestine; and the colon is less painful if traction is made in the direction of the tenia than if a sacculation is pulled upon. The mesentery, in which the nerves have little tissue surrounding them other than the elastic blood vessels, is particularly sensitive to traction.

The surrounding conditions exert a great in-

fluence on nerve sensibility. Inflammations producing much exudate are usually more painful than those attended by little, irrespective of the local character of the inflammatory process. Chronic exudates are less painful than acute. Cellular exudate is less painful than serous and serous exudate which is highly toxic to living protoplasm is more painful than exudate which is biologically innocuous; unless the toxicity is so great as to destroy the integrity of the nerves. Cold lessens pain in the viscera as well as on the surface of the body.

Inflammation Makes Organs More Sensitive

If these general principles are kept in mind elaborate rules are unnecessary. Given the anatomy of a viscus and the nature of the process the problem of pain becomes a simple deduction.

PREPARATION OF PATIENT.—When in major operations it becomes necessary for the surgeon to sacrifice the convenience of a general anesthetic, the patient's condition is such that quite as much solicitude in his preparation is necessary. To conserve the strength, limit the exposure and diminish as much as possible the time the patient is under mental anxiety are the indications to be met.

Excessive Preparation is Avoided

With local anesthesia the dietary habits of the patient need not be interfered with unless the stomach is to be attacked. The patient should be allowed his usual breakfast and preliminary local preparation of the area of operation should be avoided.

At the time of the operation the patient is made comfortable and carefully wrapped in warm blankets. If hair is abundant over the field of operation it should be dry shaved and the field sterilized with tincture of iodine. After the iodine has acted

for a few minutes it may be partly removed by alcohol.

The infiltration of the area of operation may now begin. It may follow the proposed line of incision or the line of incision may be circumscribed by an ellipse, thus blocking in continuity the nerve supply of the part. The skin itself should be first infiltrated. The subcutaneous tissue may be infiltrated before the skin is incised or the skin and subcutaneous part may be incised together down to the fascia. A subfascial injection may now be made; or, as the fascia is not very sensitive, it may be incised without a special injection if time is an element to be considered.

Infiltration Surely Necessary

The details of the injections will be decided according to the site, character and direction of the incision. If this points away from the median line transversely to the direction of the nerves, careful infiltration is necessary. If parallel with the nerves they can usually be avoided. The character of the operation and the condition of the patient are important factors. In wounds followed by drainage extensive infiltration is desirable, more particularly so because the need of drainage implies an inflammatory process.

EXPLORATORY LAPAROTOMY.—In many instances an obscure abdominal disease can be cleared up only by direct examination. Malignant disease of the digestive tract comes most frequently under this category. Usually, it is true, in malignant disease when a general anesthetic is no longer possible the chance of a cure has long since passed. However, it occurs not infrequently that in such persons an exploration is desirable to settle a question of diagnosis. Contra-indications to general anesthesia

Probable Diagnosis is Desirable Before Operation is Begun

come most frequently in old persons, in whom cardiac weakness, nephritis and pulmonary diseases are particularly common. The danger of placing such a patient in bed upon his back is well recognized. By the use of local anesthesia the recumbent position is avoided from the beginning. The usual dietary is allowed up to the very time of the operation unless it is likely that it will be necessary to enter the stomach. In this case a restricted diet for one meal is given and gastric lavage practiced immediately before the operation. An ordinary bath is given some time before the operation. The skin is prepared by painting with tincture of iodine; this obviates the risk of chilling the patient by the use of water. Whether or not a preliminary dose of morphine is to be given depends upon the general condition of the patient. A bad heart does better under a dose of morphine while in disturbed renal function it had better be omitted.

The line of infiltration may coincide with that of the proposed incision or an ellipse may be formed (Fig. 40) within which the incision is made. By either method the skin incision is quite painless. The deeper tissues should be infiltrated before the skin is incised. This is done by injecting several syringes full immediately above the fascia, for after the skin has been incised the underlying tissues can be anesthetized with difficulty. After the incision is made down to the fascia the underlying tissues may be injected. As a matter of fact the fascia and peritoneum are but slightly painful. This is particularly true if the elliptical infiltration has been made by subdermal injection. The peritoneum is incised in the usual manner. It is of advantage to make the opening of sufficient length to admit of ready ex-

ploration since there is muscular rigidity and stretching of the tissue causes pain. The length of the incision makes little difference as to shock and healing.

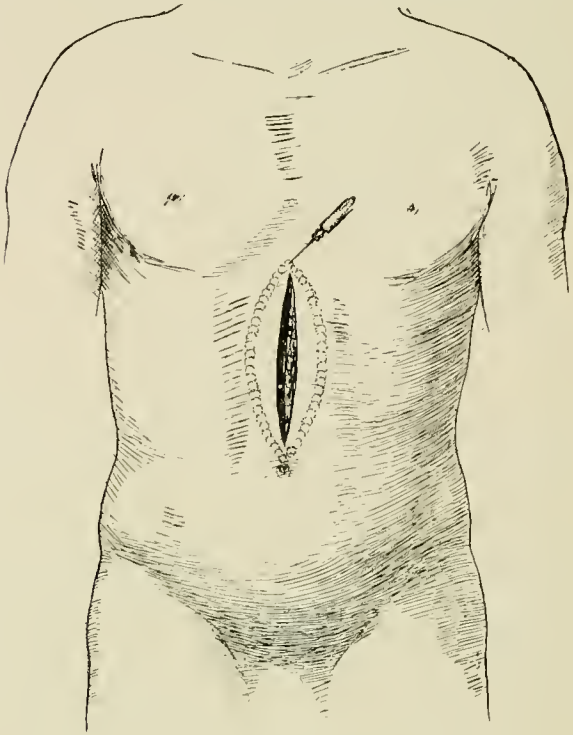


Fig. 40. Exploratory laparotomy. Incision of skin.

It is the painful manipulation and not the degree of trauma that makes for shock. It is well for the same reason to have the incision through the peritoneum shorter than the skin and fascial incisions so that it will not be necessary to grasp the peritoneum with traction forceps in closing the wound.

The material used in closing the incision should

be such that the patient may be allowed to get up at once after the operation. Catgut No. 2 chromicized, gives satisfactory results. Firm adhesive strips extending well around the abdomen make it possible in many cases for the patient to leave bed on the day of operation.

GASTROSTOMY.—When owing to carcinoma, the esophagus has become impervious, a permanent opening into the stomach through the abdominal wall is the operation of choice. Since the opening will be needed for only a brief time, elaborate plastic operations are unnecessary. Frank's operation is simple to perform under local anesthesia and gives satisfactory results. An ellipse is infiltrated over the upper left border of the rectus, and through the center of this the deeper tissues are infiltrated down to the fascia. An incision is made exposing the rectus fascia near its outer border. A superfascial injection is now made and the operation continued through the peritoneum. The stomach is grasped between the fingers and the most available portion is brought into the wound. By slow careful traction this, the most painful part of the operation, may be made without much distress. The stomach having been drawn out the required distance the peritoneum is sutured about the exposed part of the stomach wall. The apex of the stomach is next pulled through a hole made to receive it in the fascia beneath the line infiltrated in the skin and the skin is then incised at this point to expose it. The outer layer of fascia is now closed over the stomach and the exposed apex sutured in the second skin wound. The first skin wound is now closed. The apex may be opened at once if it is necessary that nourishment be administered or, if not, a few days may be al-

Be Sure it is the Stomach

lowed to elapse that healing may advance before the wound is subjected to irritation from food.

Use Ether for Your First Operations

GASTRO-ENTEROSTOMY.—The abdominal incision is made in the way already described. An anterior anastomosis is more conveniently done than the posterior, though the latter is possible under local anesthesia. Since the operation at most is palliative the anterior opening gives satisfactory results and occasions less traction than the posterior operation. The short loop may be employed according to accepted methods. The assistant's fingers make a more acceptable clamp to the patient than a metallic one. The usual technic may be employed; making first a posterior peritoneal layer, then incising both the gut and stomach, uniting the edges of these preferably by an overlying suture and finally completing the peritoneal suture. The wound is closed by the method already described.

COLOSTOMY.—The skin is infiltrated in the usual manner. Incision is made down to the muscle, which is then injected; after an interval this and the peritoneum are incised. The portion of gut to be opened is brought into the wound. If the mesentery is long it may be brought without the wound and a glass rod passed beneath. Usually, bringing the gut well into the wound and enclosing it in the peritoneum and fascia gives satisfactory results and makes less pain owing to the slight traction. The opening of the gut should be postponed several days. If this is possible the point of opening should be marked by two loops of suture so that they may be drawn upon and the incision made between them. If it is necessary to open the gut at once the suturing should be done with especial care and a double row applied.

ABDOMINAL DRAINAGE.—Drainage is required for appendicitis, and, less often, for gall stones. The usual preparation of the skin is employed and the line of proposed incision is infiltrated. The deeper tissues are infiltrated thoroughly before the skin is opened. The incision is made down to the peritoneum. When this is done the presence or absence of pus at that point can be determined by palpation. If the desired point is located, the incision is completed, the abscess explored and a drain placed. If desired the wound may be shortened by a suture at one end, but usually this is not necessary.

Indications

For acute abscess with well walled-off cavities this is distinctly the operation of choice since it is quickly done and inconveniences the patient not at all and the surgeon but little. The essential is a correct diagnosis. However, this method is not suited to draining abscesses not attached to the abdominal wall. These require packing off during the operation and are too painful to be done under local anesthesia.

UMBILICAL HERNIA.—Umbilical hernia even more than femoral is an affliction of women beyond middle life. The condition is usually complicated by a superabundance of abdominal fat which adds very much to the difficulty of the operation as done under local anesthesia. Combined with this is the fact that there are usually extensive omental adhesions about the margin of the opening. These difficulties make the operation for the radical cure under local anesthesia a difficult one and it will not be undertaken except in the face of specific contra-indications to general anesthesia. It may, however, be accomplished under local anesthesia unless the opening be very large.

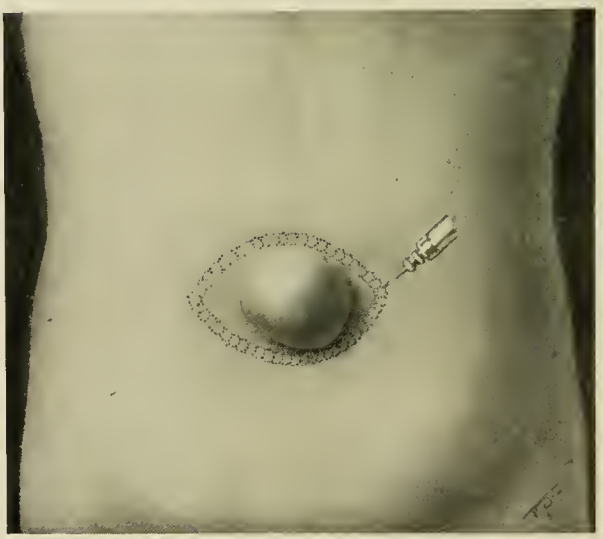


Fig. 41. Ring infiltrated about an imbilical hernia.

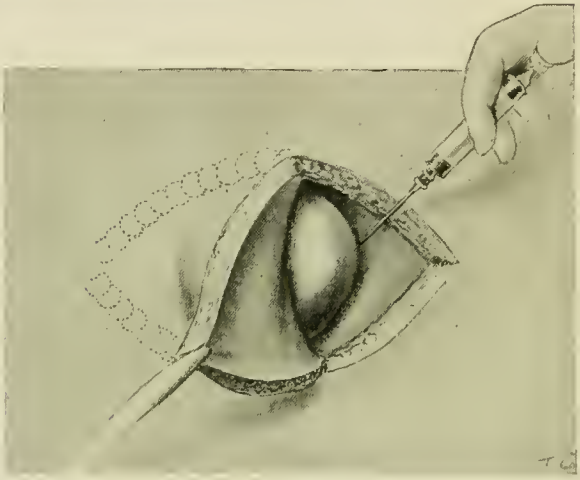


Fig. 42. Infiltration of the fascia about the ring.

An elliptical line is infiltrated about the summit of the tumor mass (Fig. 41) and the subcutaneous tissue infiltrated toward the base of the sac. The incision is made in this line exposing the mass to the point of attachment to the ring of the hernial opening. The base of the ring, including muscle and fascia, is infiltrated (Fig. 42) while the sac is still unopened and by the time this has been done about the entire circumference the sac may at once be opened.

Avoid Adherent Gut

The opening is made at the summit of the sac. If there are attachments about the border of the ring these must be loosened. The sac is then slit down to the ring and from this point the entire circumference of the ring is freed from the sac, the edge of the opening being caught up from time to time with forceps so that it may be readily identified.

When the entire sac is removed the opening is to be closed, plication according to Mayo being the method of choice. This may be done from above down or laterally as may seem easier in a given case.

Avoid Including Gut or Membrane in the Suture

A number of sutures are passed through the abdominal wall some distance from the edge, through the free edge of the parts of the ring below and through the abdominal wall again near the first suture (Fig. 43). When all are placed they are tied. Another row of sutures is passed through the free overlapping edge and into the fascia of the recti below (Fig. 44). The passing of the sutures in closing the sac must be preceded by infiltration of the region or the patient must bear some pain during the procedure. The skin is then closed in a transverse direction preferably with silkworm gut.

STRANGULATED UMBILICAL HERNIA.—Operations as done under general anesthesia for strangulated

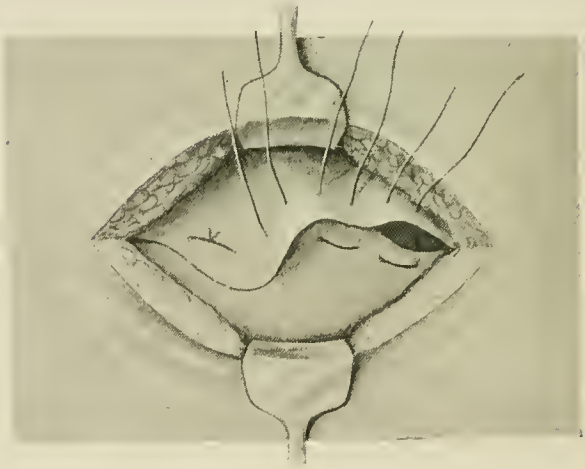


Fig. 43. The first row of sutures are passed and one of them is tied.

Fig. 44. The second row of sutures passed through the edge of the upper flap and into the fascia of the recti below the opening.

umbilical hernia are attended by a high mortality. Local anesthesia may reduce this considerably. The aim here is to release the strangulation and not to attempt a radical cure.

A line over the summit of the tumor and also the subcutaneous tissue are infiltrated. The incision is made down to and into the sac. Through this opening the point where it will be easiest to relieve the constriction is determined. Sometimes this can be done from within the sac by nicking the constricting ring after infiltrating.

Avoid Injuring the Gut

Sometimes it will be necessary to expose the ring from without. In that event the base of the sac is exposed at the point where it is intended to enlarge the opening; it is infiltrated and then with the finger as a guide within the sac it is cut down upon from without the sac.

If the gut is viable it is returned, otherwise it must be retained within the opening.

If the gut is returned the opening into the sac is sutured and the radical cure of the hernia is carried out at a later date.

# CHAPTER XII

## Operations Upon the Inguinal and Scrotal Region

The scrotum, being supplied with terminal nerves of definite distribution, is one of the most satisfactory regions for the performance of operations under local anesthesia. Inguinal hernias are traversed by the same nerves which supply the scrotal region. These nerves are exposed during a herniotomy, and may be blocked in the course of the operation.

In all operations in which nerve blocking is practised an accurate knowledge of nerve distribution is required. Since this knowledge can be but imperfectly gained from text-books it seems desirable to include at this point a discussion of the nerve supply of the region.

Neural Anatomy

The three nerve trunks which supply the inguinal region, mentioned in the order of their importance, are the ilio-inguinal, genito-crural and ilio-hypogastric (Fig. 45).

The Upper Scrotum

The ilio-inguinal reaches the field of interest after piercing the internal oblique muscle and traversing the short distance between this muscle and the aponeurosis of the external oblique. Within the inguinal canal, it lies upon the cord toward its lower border. At the median (external) ring it becomes cutaneous and supplies the upper and inner portion of the thigh and, according to most anatomists, the upper portion of the scrotum and the root of the penis in the male and the upper portion of the labium majus in the female (Fig. 45).

THE GENITO-CRURAL nerve divides at the third lumbar vertebra into the genital and crural branches, both of which are of interest in operations under local anesthesia in this region, the genital branch in

The Inguinal Canal

Fig. 45. Nerves of groin.

inguinal and the crural in femoral hernias. The genital branch after crossing the external iliac artery passes forward and downward, enters the inguinal canal, where it lies below and behind the cord, and enters the scrotum. The crural branch enters the thigh by passing beneath Poupart's ligament external to the iliac vessels. One branch enters the

saphenous opening while the remainder of the nerve pierces the fascia lata external to the saphenous opening and supplies the skin on the anterior surface of the thigh.

The Pubic Region

THE ILIO-HYPOGASTRIC NERVE. This nerve reaches the inguinal region by passing along the crest of the ilium between the transversalis and internal oblique muscles. At a point two inches behind the anterior spine of the ilium it divides sending one branch (the iliac) over the crest of the ilium to the region of the great trochanter, while the other (the hypogastric) perforates the internal oblique near the anterior superior spine and courses inward beneath the fascia of the external oblique muscle which it pierces an inch above the external ring.

The statements of the anatomists and the researches of Cushing do not agree as to the innervation of the scrotum. According to Cushing the scrotum is not supplied by the nerves above described. The discrepancy may possibly be explained by an overlapping of the nerves in this region such as has been observed on the head and face after the removal of the Gasserian ganglion. It is possible, therefore, that the anatomists are correct in their belief that these nerves supply the upper portion of the scrotum, but as it may also be supplied by nerves from the sacral plexus, sensation remains after anesthetization or section of the nerves in question. It is sufficient for the purpose of local anesthesia to remember that the blocking of the nerves running in the inguinal canal does not give anesthesia for the skin of the scrotum as it does for the scrotal contents and that if the scrotal skin is to be attacked infiltration is necessary.

The scrotal and perineal regions and the anal-

ogous region in the female, as intimated in the preceding paragraph, are supplied by a separate set of nerves. These are derived from the pudic nerve or from the small sciatic nerve, both of which originate in the sacral plexus. This has been definitely proven not alone by determining that anesthesia in this region is not produced by section of the nerves traversing the inguinal canal, but also by demonstrating that in cases of compression fractures at the twelfth dorsal vertebra, the scrotum becomes anesthetic although the inguinal group of nerves is uninjured (Cushing). This would make it appear that the anatomists are wrong in believing that the inguinal group also supplies the upper portion of the scrotum.

The Scrotum

HERNIAS.—Operations for hernias, particularly inguinal hernias, have been more frequently done under local anesthesia than any other operation of like magnitude. The reason for this popularity has been the desire of the patient to escape the general anesthetic. The surgeon has acceded to the wish of the patient because the technic for local anesthesia for inguinal herniotomy is relatively easy to acquire, thanks to the lucid presentation of the subject by Cushing.

This surgeon began the use of local anesthesia in this operation only in those cases in which general anesthesia was contra-indicated. He discovered that when patients remained in the ward long enough to observe the effects of operations under both general and local anesthesia, they invariably preferred the latter method. My experience has been quite in accord with this.

Test of Efficiency

Even more convincing are those instances in which a patient, who has had one side operated upon under

general anesthesia and subsequently is operated on the other side under local anesthesia, strongly urges his friends to select the latter method. The patients declare that the inconveniences of the general anesthetic are greater than the pain, if there is any, of the operation under local anesthesia.

The surgeon's interest in local anesthesia for hernia operations lies primarily in the fact that many persons seek a radical cure for their hernias when it can be done without general anesthesia who otherwise refuse radical treatment. The convenience to the nursing staff is great since much less care is necessary after local anesthesia. It has been urged that local anesthesia is of great advantage because of the certain avoidance of vomiting. So far as the comfort of the patient is concerned this is unquestionably true, but so far as the results of the operation are concerned there is little choice, since cure is equally certain after either method.

The chief reason for the preference of local anesthesia is the lessened suffering of the patient, which advantage is purchased at a slight sacrifice on the part of the surgeon. Greater care in manipulation is required when operating under local anesthesia and more time is required for the performance of the operation. Under general anesthesia fifteen or twenty minutes are required, while under local anesthesia, twice as much time will ordinarily be consumed.

In those cases, therefore, in which there is no positive indication for general anesthesia, the slight, though definite, degree of danger is avoided by the use of local anesthesia. There are a number of conditions in which the use of local anesthesia is mandatory upon the surgeon; namely, those cases in

which renal, cardiac or pulmonary diseases contra-indicate the use of general anesthesia. It may be argued that persons so affected should be allowed to retain their hernias. Aside from instances in which operation is compulsory because of strangulation, many cases are attended by great discomfort which cannot be relieved by trusses. Frequently persons who have worn a truss successfully for many years, discover when they pass the meridian of life, and their tissues lose elasticity, that they are no longer able to retain their hernias by such means. To such persons local anesthesia offers a certain and safe means of riddance from a very troublesome malady.

Practically all hernias can be operated under local anesthesia. The simple inguinal variety, because of the accessibility of the nerve supply, lends itself particularly to operation under local anesthesia, but femoral and umbilical varieties likewise may be attacked by this method. Intermuscular and interstitial hernias, because of the large area they sometimes occupy, are least favorable, and large omental hernias with adherent sacs and sacs which have been treated by injection sometimes offer difficulties; but all can be operated under local anesthesia. The mere size of the hernia influences the difficulty of the operation very little. In the more difficult types, when no contra-indication exists, general anesthesia is preferable because of the greater speed with which the operator is able to work. But if such contra-indication does exist, then local anesthesia should be chosen.

The technic of the operation naturally varies for the different kinds of hernias and they may be taken up in order.

INGUINAL HERNIA.—Any of the standard oper-

ations may be done under local anesthesia. The most important step in the operation is the proper treatment of the sac. It is only when hernias have become large that the suture of the various layers is of great importance. The "restoration of the canal" does not apply to small beginning hernias because the canal is intact. In large hernias the of importance. In these cases Halsted's method is perhaps the best; at least as much as the typical Bassini operation should be done. The beginner will do well to avoid these large hernias and the experienced will find no difficulty in managing them canal is detroyed and the restoration of the canal is under local anesthesia.

The operation described below is the one most easily done under local anesthesia because of the minimum manipulation of the cord. It is based on Ferguson's operation.

The Skin Incision

Ordinarily the skin incision is made over the inguinal canal beginning beyond the internal ring and ending over the root of the scrotum. This gives the most ready access to the inguinal canal and is perhaps the incision of choice for beginners. It is objectionable because it invades a region normally covered by hair, and no matter how careful the preparation, the likelihood of infection is greater than when the incision is made higher up on the abdomen. The low incision is objectionable likewise because the dressings are held in place with difficulty while with the higher incision the ordinary adhesive strips and abdominal binder may be used. The low operation should be dressed by a figure of 8 bandage or by adhesive strips passing about the thigh and over the groin. The spica bandage if made tight causes pain when the thigh is extended and if loose

does not hold the dressing when the thigh is flexed. Another advantage of the high incision is that should the skin wound become infected it is some distance from the fascial sutures and the deeper structures are less likely to become involved. Large hernias occupying the scrotum, particularly irreducible and strangulated hernias are better managed through the low incision.

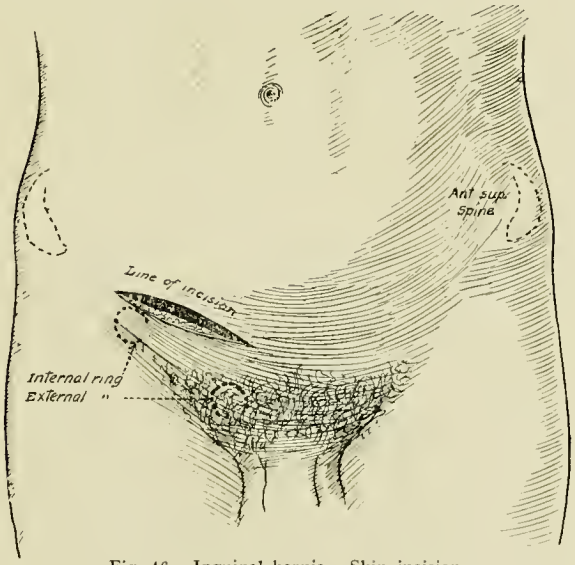



Fig. 46. Inguinal hernia. Skin incision.

For these reasons I prefer an incision beginning 5 centimeters internal to and 2 centimeters below the anterior superior spine (Fig. 46). The skin infiltration is begun at he point nearest the operator. Endermic infiltration is employed. The length of line infiltrated will depend upon the kind of hernia, the amount of fat and the experience of the operator. Two

to three inches will ordinarily be required. This would form a line extending from the point of beginning noted above to a point above the external ring. The skin alone is infiltrated and a syringeful is injected deeply into the subcutaneous tissue at the inner extremity of the line of infiltration. This is made for the purpose of anesthetizing the hypogastric branch of the ilio-hypogastric nerve.

**Anesthetic of Choice**

The anesthetic depends upon the choice of the operator. I formerly employed one half of one per cent. cocain solution as recommended by Cushing. I now use $^4/_5$ of one per cent. quinine solution (4 grains of quinine and urea hydrochloride dissolved in 1 oz. of sterile water). The most popular anesthetic at he present time is novocain in 1 per cent. solution.

**Ligation of Inferior Epigastrics**

As soon as the injection is finished the incision may be begun. It should extend just through the skin exposing the subcutaneous fat, so that the superficial inferior epigastric vessels may be recognized before they are cut (Fig. 47). These vessels are isolated and clamped, cut and ligated (Fig. 48). Accompanying these vessels and lying to the lateral side is a small nerve. This may be anesthetized according to Schleich by the application of 5 per cent. carbolic acid or the slight pain may be disregarded. I follow the latter method because the pain is never great and often absent. At the inner end of the incision the superior pudic vessels are encountered. These likewise should be recognized and secured before they are cut. If the low incision is made the deep external pudic artery and nerve of same name may be severed, usually before they are recognized. It is well, therefore, in making the low incision to make a subcutaneous injection at the lower end of

Fig. 47. Incision into the subcutaneous fat exposing the superficial inferior epigastric vessels.

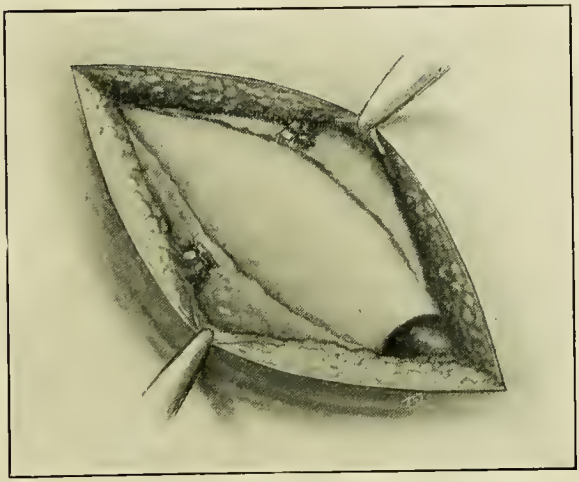


Fig. 48. The vessels are ligated and cut. The fascia of the external oblique forms the floor of the wound. The external ring is exposed at the lower end.

the line of infiltration before the skin incision is begun. The vessel should be recovered and ligated.

The Incision of Sub-cutaneous Tissues

The incision is now made rapidly down to the fascia of the external oblique. Immediately above the fascia are some fine filaments that often cause a moderate amount of pain. The most painful point is above the arching fibres of the external ring. These may be injected before the incision is made or severed without infiltration. I follow the latter course because edematous fascia is poor material for suturing. The looseness of the tissue makes necessary a considerable amount of fluid and some time must elapse before the anesthetic effect takes place. The patient admits pain, may even volunteer an objection and in rare cases emphasize it by flexing the thigh slightly in protest. These things are but momentary and do not weigh against having the tissue in the best condition for certain union.

The Incision of Fascia

The external oblique fascia is now incised from the external ring to a point 1 centimeter above the internal ring, parallel to and 1 to 2 centimeters above Poupart's ligament. The edges of the fascia are picked up with forceps (Fig. 49) that they may be easily recovered and to prevent their being inadvertantly sutured to the conjoined tendon. This also furnishes a convenient retractor.

Blocking of the ilio-inguinal nerve

The inguinal canal containing the sac, nerves and spermatic cord is now exposed. By careful manipulation the inguinal branch of the ilio-inguinal nerve is exposed. The nerve usually lies above and anterior to the cord and can be found without difficulty if the field of operation is kept free from blood. If the nerve divides into a number of filaments before it enters the inguinal canal some difficulty may be experienced. When exposed the nerve is picked up

gently with forceps and 10 m. of the anesthetic solution is injected into the sheath. Cushing recommended the use of a 1 per cent. cocain solution. This is the most efficient but it requires a second solution. For this reason I have used the $^1/_2$ per cent. cocain or the $^3/_4$ per cent. quinine solution used for the skin infiltration. With care the sheath

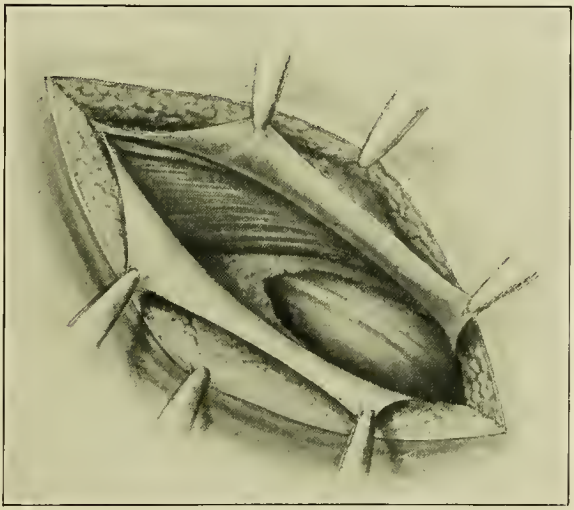


Fig. 49. The fascia is cut and its edges retracted, so as to expose the cord and sac with the nerve on top.

may be distended sausage-like to within the internal ring. The advantage of this distension is that a quick anesthesia is secured with the weaker solution. The nerve is then pushed to one side and is not further molested. The cord is now infiltrated at the point where it escapes from the internal ring. The needle is directed toward the opening of the canal. About 1 cubic centimeter of the solution may be used. If the cord is gently lifted from its bed and

injected while being held between the thumb and fore finger the infiltration is more effective but some pain is caused by the manipulation.

**Isolation of the Sac**

The sac is then sought. It lies immediately below the nerve anterior to and above the cord (Fig. 50). By picking up the structures above the cord the sac

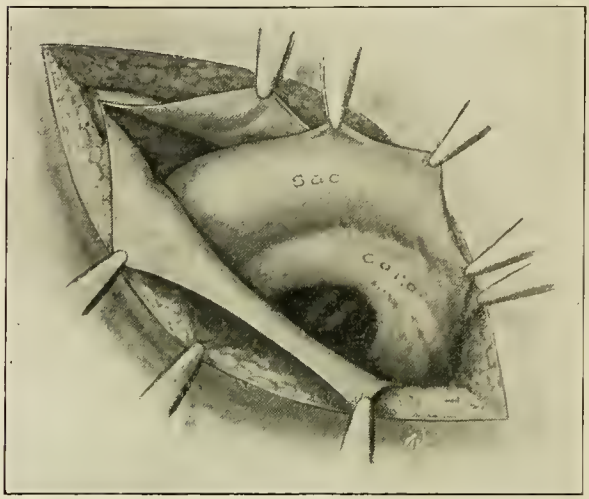



Fig. 50. Sac and cord lifted from their bed. Deep epigastric vessels in the wound.

can usually be recognized without difficulty because of its pearly color as compared with the pinker, more transparent tissue below it. If the operator is familiar with the appearance of the sac it is most easily isolated by the strokes of a knife. The beginner will do better work with the gauze armed finger. The sac is isolated from the cord to the point of its disappearance into the internal ring.

If not previously done the sac is now opened

before it is ligated. The finger is pressed into the sac to the point of proposed ligation to make sure the canal is free (Fig. 51). A curved needle carrying a No. 2 catgut is passed eye end first. The ab-

**Ligation of the Sac**

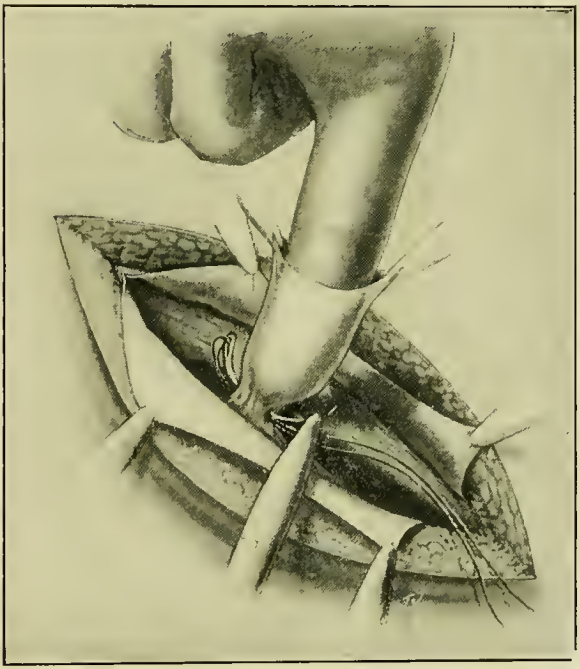


Fig. 51. The sac is separated, and opened. A needle is passed eye-end first through its base.

dominal contents are kept out of the way by the finger of an assistant or by a closed forceps. The sac is then tied doubly and cut 1 centimeter distal to the ligature. The sac when released should slip into the abdomen if it has been drawn down as far as possible before the ligature is placed.

If the sac is short it is removed entirely. If long it should be dissected loose as far as the external ring and the remainder allowed to remain. If the formation of a hydrocele is feared the remaining portion of the sac may be obliterated by whipping it together with a catgut suture. I have never seen a hydrocele form after this treatment. The advantage of treating the sac in this manner is that less trauma is produced and consequently less oozing results. If desired the entire sac may be removed for if the nerve is blocked as above recommended the contents of the entire canal are anesthetized.

Restoration of the Canal

The restoration of the canal, as it is called is now done. A suture is placed uniting the conjoined tendon to Poupart's ligament (Fig. 52), the cord being displaced backward. Three or four more are placed in like manner. In placing the sutures the edge of the needle should be guarded by the end of the finger to prevent injury to the deep epigastric vessels. If difficulty is experienced in locating the ligament it may be fixed with forceps. Space must be allowed at the lower end of the suture line to permit the escape of the cord.

It now remains to close the fascia of the external oblique. A suture is passed through the edge at its lower extremity of the fascia restoring the external ring. An opening must of course be left at the lower angle for the exit of the cord (Fig. 53). The remainder of the severed edge of the fascia of the external oblique is now united. Interrupted sutures give securest union and are to be preferred. If desired the edges may be imbricated.

The closure of the skin may be accomplished by any method desired. Fine silkworm or horsehair is the most desirable, but fine catgut is the most con-

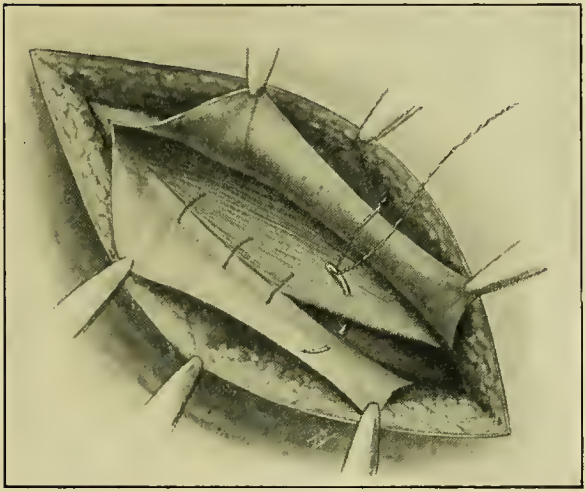


Fig. 52. Sutures through the conjoined tendon and Poupart's ligament. The cord beneath.

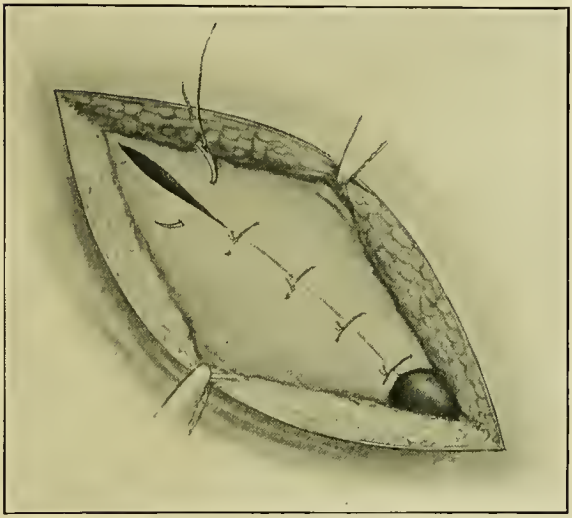


Fig. 53. The fascia closed with interrupted sutures, leaving an opening at lower end for the cord.

venient. The sutures need be but tight enough to hold the skin edges in loose coaptation. If quinine has been used it is certain that the skin is still anesthetic. If cocain is used, according to most authors the anesthesia may have disappeared. My experience has been that even if cocain is used the skin is still anesthetic. There may be already a zone of hyperesthesia beyond the infiltrated line and if this is grasped brusquely the hyperesthesia from this zone may be mistaken for a vanished anesthesia in the line of original infiltration.

If desired the typical Bassini operation may be performed, though the dislocation of the cord offers some difficulty, and may cause a sickening sensation if done roughly. If the cord is gently raised and its edge is fixed the sutures may be readily passed. In large hernias the Bassini operation should be performed.

**Operations with Schleich's Solution**

When Schleich solution is used the skin and subcutaneous tissue may be tensely infiltrated, which may require several ounces of the fluid. After some minutes have elapsed the operation may be proceeded with. The fascia is exposed and infiltrated, and the cord is infiltrated before the canal is opened. This method is simpler than the one described since it is not necessary to keep the location of the nerves in mind.

The objection to the employment of large amounts of fluid is that with the dilution of the tissue fluids the processes of repair are interfered with. In many operations this is a matter of no consequence, but in the operation for hernia where the success depends in part upon firm union of the severed fascia it becomes a matter of importance. I believe that

adrenalin interferes with healing more than the anesthetic solutions.

After hernia operations, patients are kept in bed for a week for simple cases and for two weeks when the hernias are large. After this time they may be allowed to get up and after three or four weeks may go about their business.

STRANGULATED INGUINAL HERNIA.—In strangulated hernia local anesthesia finds a field peculiarly its own. The prime indication in these cases is an early release of the strangulation. The accident often occurs away from the usual conveniences of hospitals and the practitioner is often without assistance. Under local anesthesia the strangulation may be relieved without the delay incident to the calling of professional consultation.

The incision is always made in the line of the inguinal canal because it makes the operation easier and facilitates fixation of the loop in case there should be gangrene of the gut. Even in the absence of gangrene, drainage of the wound may be advisable for suppuration is likely to take place and the low incision gives better drainage.

A line is infiltrated from the base of the scrotum to well above the inguinal ring. The subcutaneous tissue should be infiltrated at the lower extremity of this line before the incision is made. If the hernia has been much manipulated and is tender to the touch the entire subcutaneous tissue should be infiltrated.

The incision is now made down to the fascia, care being taken to ligate the superficial inferior epigastric vessels as recommended above.

The subfascial tissue is now infiltrated by passing the needle just beneath the fascia of the external

oblique, injecting the solution between it and the sac. Several cubic centimeters may be employed with advantage.

The fascia is now split up from the external ring to well beyond the internal ring. The edges of the

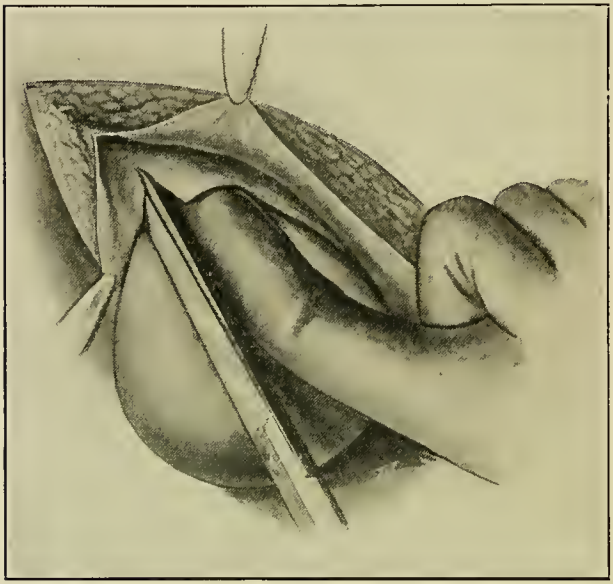


Fig. 54. Exposure of sac and cutting of constricting ring.

fascia should be grasped by forceps so that they may be readily identified.

The arching fibres of the muscle above the internal ring should now be infiltrated. This is the point where the constriction must be incised to relieve the hernial contents.

Incision of the Constricting Ring

The ring is now accurately located outside the sac and snipped upward and outward until the finger

can be passed between the sac and the widened ring (Fig. 54). The hernial contents should not be allowed to slip back until they are inspected for necrosis. When a very small loop is strangulated it may be advisable to open the sac before the ring is widened. The advantage in incising the ring outside the sac is that there is no danger of wounding the contents and the peritoneum is not injured.

Inspection of Contents of Sac

The sac is now opened and the contents inspected. If they are thoroughly viable they are allowed to slip into the abdomen. If not certainly viable they are slightly withdrawn and allowed to remain in the opening. Hot cloths may restore the circulation in a short time. If doubt still remains the suspected loops should be fixed in the opening and hot cloths continuously applied. Often after many hours the circulation may be restored. If the loop is not viable the gut should be fastened into the opening and an artificial anus be made. The gut should not be anastomosed at the first operation, experience having shown that the mortality is much less if the anastomosis is postponed for a secondary operation.

Immediate Anastomosis is Inviting but Fatal

If there is necrosed or thrombosed omentum in the sac this may be ligated and removed.

If the hernial contents are viable and have been returned the ring should be examined before closing the wound by sweeping the finger about in order to make sure that there does not remain a deeper constriction still holding the loop.

The closure of the canal, if the strangulation is very recent, may be made as in a typical herniotomy. If there has been much exudate, but the intestine is viable, closure may be made, but there should be drainage down to the fascia to permit the escape of fluid which will certainly form. In this way sup-

puration may be prevented. Should this occur the entire wound must be reopened. If suppuration seems likely it is well to place untied sutures in the skin. After reaction has taken place they may then be tied.

If an artificial anus has been made resection of the gut may be made after some weeks. This is done under general anesthesia.

The after treatment depends on the condition present. Those operated early recover as quickly as after an ordinary operation for the cure of hernia. If there is much reaction the patient should be kept in bed a longer time.

Quinine is by all odds the anesthetic of choice in the operation for strangulated hernia. It is used in the usual strength.

FEMORAL HERNIA.—The neural anatomy of femoral hernia is such that nerve blocking cannot be employed and infiltration without regard to the nerve distribution must be employed.

**The Incision**

The incision may be made parallel with the long axis of the body with its center over the hernial site or parallel with and a finger's breadth below Poupart's ligament. The vertical incision is preferable since fewer nerves are cut and strangulation is easier relieved through this incision.

The skin is anesthetized by endermic infiltration.

**Exposure of the Sac**

The incision is made through the skin exposing the superficial vessels. They should be caught up before they are cut. The region about the base of the sac is now infiltrated. The loose fat must be removed before the sac is reached. Usually the best point to isolate the sac is just below Poupart's ligament (Fig. 55). When exposed at this point it is separated from above downward. At the lower part

the long saphenous nerve approaches the femoral vein and must be protected.

Avoid the Femoral Vein

The sac when liberated is ligated as near as possible to Poupart's ligament and the redundant

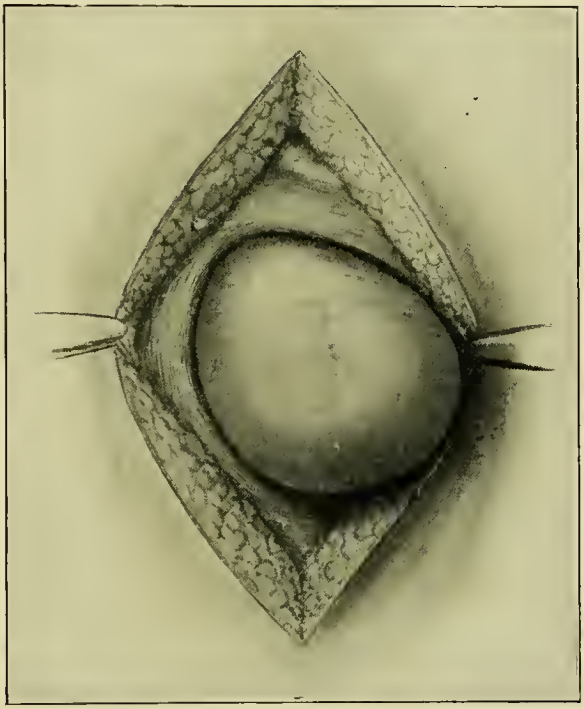


Fig. 55. Isolation of hernial sac. Poupart's ligament shown above.

portion removed. The stump is then made to retract beneath the ligament.

Closure of the Ring

The closure of the ring must be preceded by the proper preparation of the ring. The fat must be removed from the falciform ligament and from the fascia lata. Sutures are passed through Poupart's

ligament and into the fascia lata. These are tied snugly. Other sutures are passed through the falciform ligament and the fascia lata as near as can safely be done to the long saphenous vein.

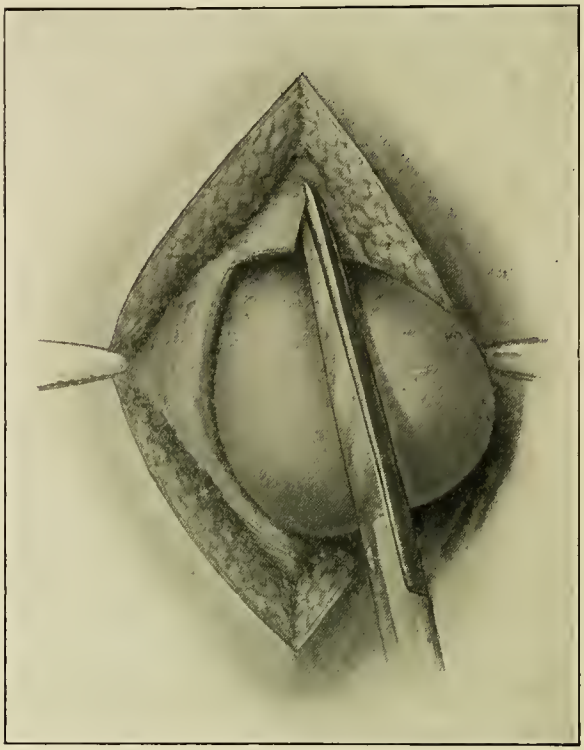


Fig. 56. Division of Poupart's ligament.

The skin is then united preferably with interrupted sutures.

STRANGULATED FEMORAL HERNIA.—Strangulated femoral hernia is eminently an accident of women

beyond middle life. These even more than strangulated inguinal hernia demand immediate relief.

The skin infiltration may be made as for the radical cure of femoral hernia, but the skin about

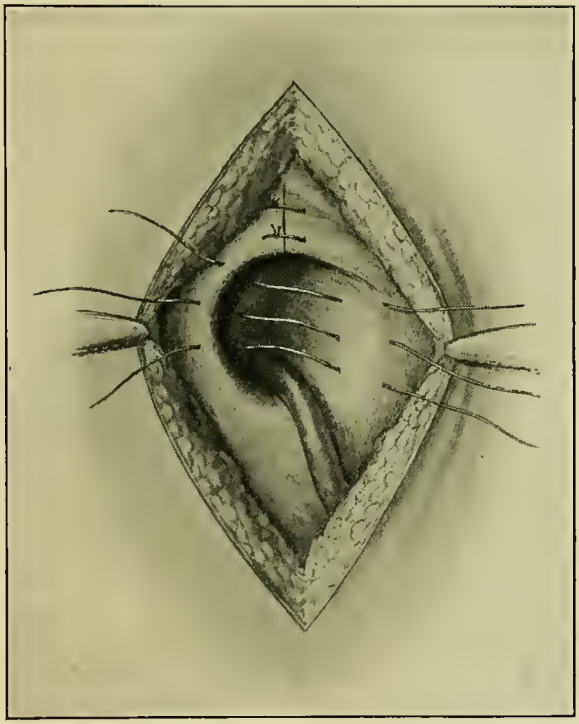


Fig. 57. Poupart's ligament closed. Sutures for closure of ring passed but not yet tied. Saphenous vein below.

the tumor should be infiltrated before the skin is incised. The skin and subcutaneous tissue over Poupart's ligament should be infiltrated.

The incision is made down to the sac which, when exposed, should be opened and inspected. The con-

striction may be relieved by nicking Gimbernat's ligament as usually advised, or better through Poupart's ligament directly upward (Fig. 56). In incising Poupart's ligament the presence of the deep epigastric vessels above and below should be remembered. It is never necessary to extend the incision upwards far enough to endanger these vessels. If the incision is terminated as soon as the constriction is relieved there will be no danger.

The constriction being relieved the constricted loop is drawn slightly downward so that the region constricted can be inspected. If viable it is returned into the abdomen. If questionable it must be retained in the opening until the viability may be determined. If certainly necrotic an artificial anus is made. Here as in inguinal hernia anastomosis should not be made at the primary operation, no matter how good the patient's condition seems to be.

If the loop of gut is viable the sac may be tied off as given above and the opening closed as described. The sutures of the incised Poupart's ligament are placed as shown in Fig. 57. A flap of pectineus fascia may be deflected upward and be included in these sutures. Experience with this method of dealing with the ligament has been satisfactory. The operation is completed by sutures passed through the edges of the saphenous opening. The saphenous vein must be protected. Often the sac cannot be isolated with facility. In that event the opening may be packed and allowed to fill by granulations. If there has been much injury to the gut packing is preferable.

The presence of the femoral vein beneath the falciform ligament should be remembered, for the injury to this vein must be reckoned as one of the disasters of hernia operations.

# CHAPTER XIII

## Operations upon the Scrotal Contents

VARICOCELE.—Operations for varicocele have for their object the obliteration of the veins of the pampiniform plexus, varicosities of which constitute the prominent objective symptom of the disease. Prominent factors in the symptomatology are the backache and certain psychic disturbances preceding, accompanying or following the pampiniform dilatation. Relaxation of the scrotum, which permits the weight of the testicle to tug constanly upon the cord, is responsible in large measure for the backache and perhaps for some of the psychic disturbances. The requirements of the operation in any given case will depend upon the conditions present. If the scrotal relaxation is marked this requires attention. If the vessels alone are affected the resection of these only will give the desired result. The ideal operative scheme must be such that each of these may be given the attention the conditions present demand. Any of the classical operations may be done with satisfaction under local anesthesia. The operation here proposed has the merit that both factors in the disease may be given attention through a single small incision.

RESECTION OF THE VEINS.—Beginning immediately below the base of the scrotum a line is infiltrated in the general direction of the cord (Fig. 58), extending downward $1^1/_2$ inches. This anesthetizes the cutaneous nerves only, which, it will be remembered, are branches from the sacral plexus through the perineal

Neural Anatomy

nerves. The scrotal contents are supplied by the nerves accompanying the cord through the inguinal canal. At the point of operation they have divided

Fig. 58. Line of skin infiltration.

into branches too fine to be blocked as described for inguinal hernia. Perineural blocking must therefore be resorted to. This is done by grasping the cord

Fig. 59. Method of grasping the cord for blocking.

between the thumb and finger at the base of the scrotum and making firm pressure (Fig. 59). The

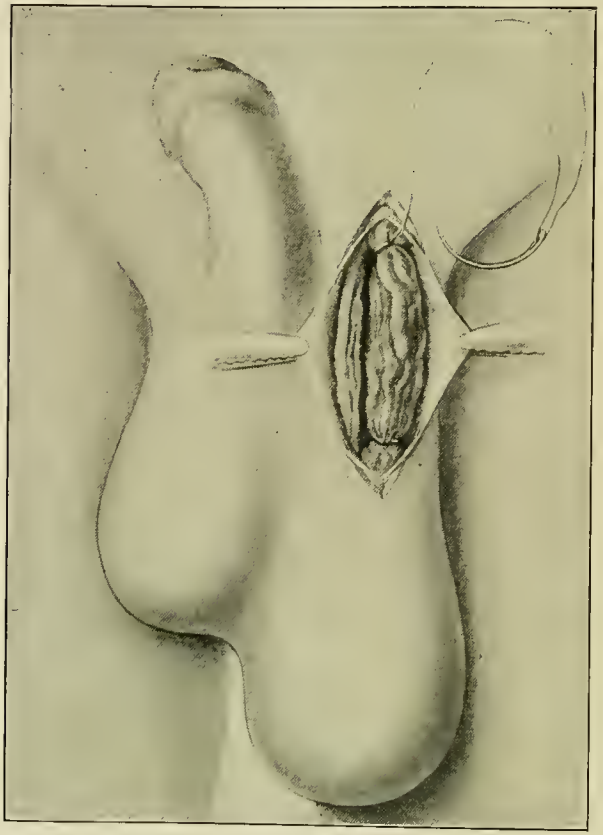


Fig. 60. The tunica vaginalis has been incised and is being held by forceps.

needle is passed at the upper end of the line already infiltrated into the tissues imprisoned between the thumb and finger. About 1 cubic centimeter (15

minims) is injected at this point. This effectually blocks all the nerves leading to the scrotal contents.

Exact Hemostasis Required

The incision is then begun in the line already infiltrated. Branches of the external pudic artery are

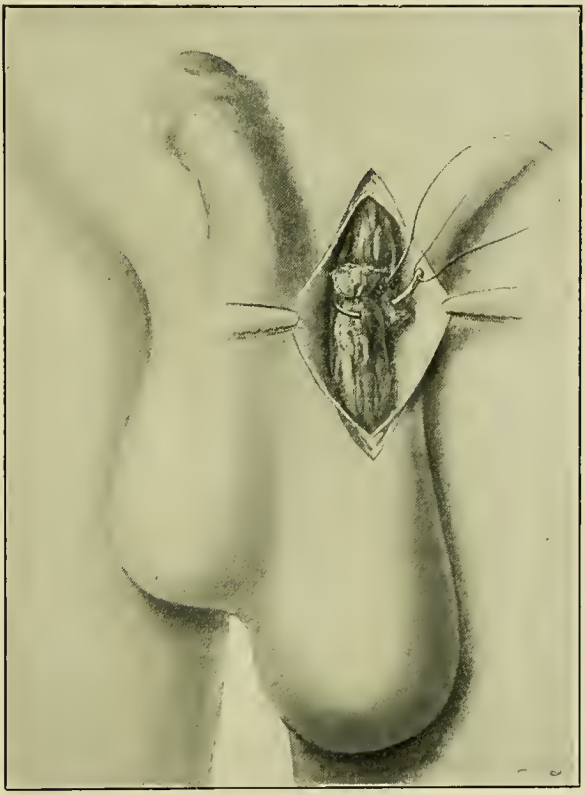


Fig. 61. The severed ends of the veins are united by suture.

severed and should be ligated at once. The tunica vaginalis is identified and held by forceps (Fig. 60). The cord with the enlarged veins is separated from its sheath and all structures identified. The vas

deferens with its accompanying artery and several small veins are separated to be preserved. Included with these are a number of nerve filaments. The bundle of veins remaining is to be resected. The veins are freed from the vas and its accompanying structures for a distance greater than the amount of tissue to be removed. The upper and lower limits are then tied with catgut and the intervening tissue removed. The severed ends are then united by tying the ends of the ligatures together and additional security is assured by passing supplemental stitches through the stump (Fig. 61). The tunica vaginalis is now closed by a separate line of sutures (Fig. 62). The skin is closed in a longitudinal direction (Fig. 63) by either catgut or silk.

Do Not Forget the Vas

By closing the longitudinal incision in the tunica transversely a shortening equal to the length of the incision is secured. By varying the length of the incision any degree of shortening may be secured. By this means a fascial support is secured for the testicle. The results are the same as those secured by scrotal amputation without the need of a skin resection.

Instead of injecting the cord through the unopened skin the cord may be separated after incision of skin and tunica and then grasped between the thumb and finger and injected. This method is more easily accomplished, but the separation of the cord before injection is accompanied by some pain.

AMPUTATION OF THE SCROTUM.—If preferred the classical amputation of the scrotum may be performed. Ordinarily the degree of shortening is estimated and the distance determined is clamped off with long-bladed forceps. Moynihan's intestinal forceps are excellent for this purpose. The skin

below the forceps is then infiltrated with quinine or Schleich solution No. 2, and the amputation proceeded with, the clamps being still in position. Through and through sutures are then placed and tied.

Since the shortening of the tunica alone is of importance and the removal of the skin incidental and unimportant the clamps are best avoided, because when they are placed, the tunica is apt to retract and the purpose of the operation is defeated. The following method, therefore, is to be recommended as permitting the operator to remove with greater exactness the desired amount of the tunica.

The amount of the scrotum to be amputated is estimated by drawing the redundant portion between the fingers. If the operator doubts his ability to follow the imaginary line so formed it will be well to paint a line with tincture of iodine. This line is then quininized about the entire circumference of the scrotum. The skin is then cut through to the tunica with scissors. The tunica is then taken up and the amount to be removed estimated by drawing it between the fingers. The tissue is quininized while the grasp is retained. The portion representing the intertesticular septum should receive especial attention because nerves are abundant at this point. The excision of the tunica is then completed, care being taken to secure the sac from retraction; any bleeding points are caught up and ligated as they are cut. Careful hemostasis should now be made in order to secure every bleeding point. Otherwise, postoperative hemorrhage into the sac will cause embarrassment during convalescence. The two layers of the tunica are united with catgut. The skin is then united as a separate layer, preferably by non-absorb-

Exact Hemostasis is Required

able sutures. Since hemostasis has been accomplished by separate ligatures the skin sutures should be only tight enough to secure apposition of the

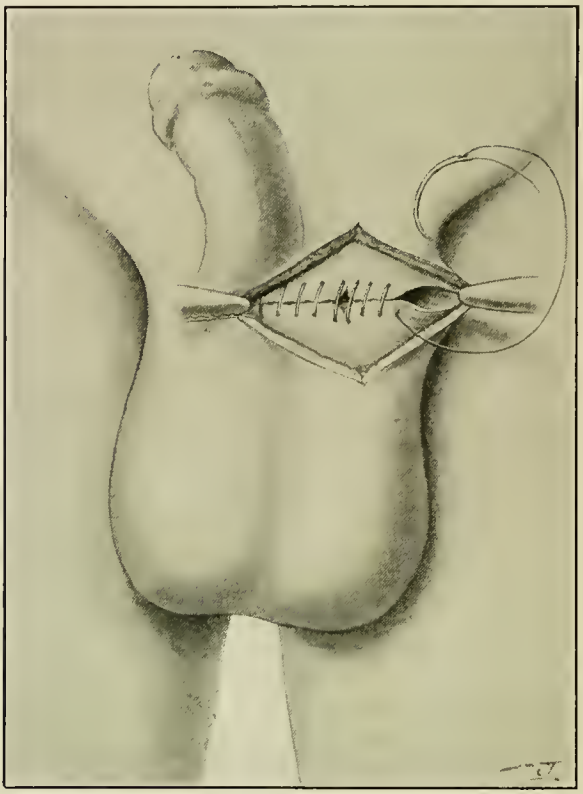


Fig. 62. Closure of the incision in the tunica vaginalis in a transverse direction.

skin. Care on this point will greatly shorten the period of convalescence from the operation.

HYDROCELE.—In the radical operation for hydro-

cele the same skin infiltration is employed as in the varicocele operation; but it is placed lower, and may be lengthened with advantage. The incision is made

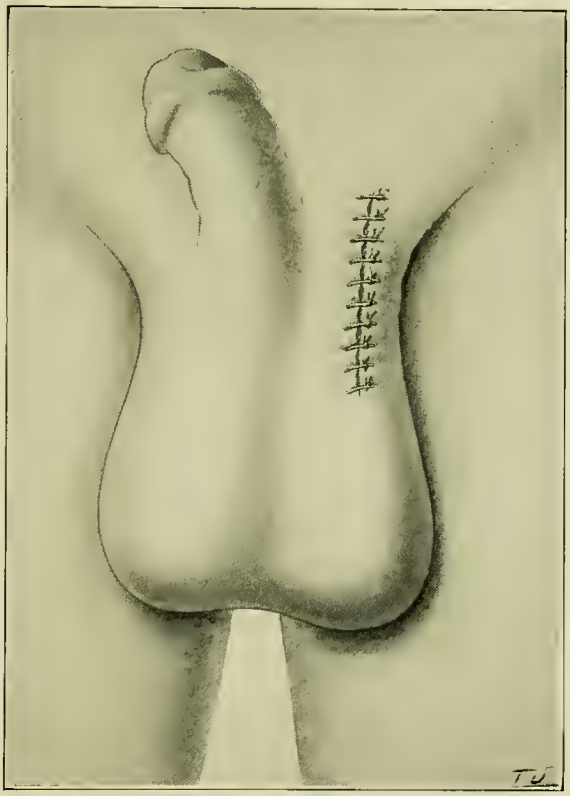


Fig. 63. Closure of the skin incision by interrupted sutures.

through the skin down to the tunica vaginalis. The cord is exposed above the tunica, and loosened carefully with finger and forceps until it can be grasped between the thumb and finger. The injection is then

made as in varicocele. The cord may be infiltrated before making the skin incision as in varicocele.

With the infiltration of the cord the entire area becomes insensitive and the tunica can be separated with ease and the desired resection made. Care must be taken to make the separation just external to the tunica for, if the separation is made between the skin and the dartos, pain will result, because the skin of the lower scrotal region is supplied by the perineal nerves, which are unaffected by the quininization of the nerves accompanying the spermatic cord. For the same reason, if it is desired to drain the base of the scrotum, the skin must be anesthetized at the desired point of incision. For the ordinary hydrocele operation a drain is not required. An interrupted non-absorbable suture, after all hemorrhage has been controlled, should be used to close the wound.

CASTRATION.—The removal of the testicle is the simplest operation upon the external genitals to be performed under local anesthesia. The technic required consists merely in exposure and ligation of the cord. This may be accomplished at the base of the scrotum or in the inguinal canal. In the former location the technic is identical with the first steps of the operation for varicocele and in the latter situation the cord is approached as in the operation for inguinal hernia.

The site of the incision will be dependent upon the condition requiring castration. If the lesion is local, as in hematocele, exposure of the cord at the base of the scrotum is to be preferred. Castration, however, is usually done for malignant disease. In that instance the ligation of the cord should be made as high up as possible. The cord should be exposed

in the inguinal canal. If the testicle is large the incision must be extended over the base of the scrotum in the direction of the cord until the testicle can be removed from the scrotum. With testicles which are very large or adherent this incision may require to be extended well over the height of the tumor.

The tumor being dislocated the cord is freed to the internal ring and drawn out of the abdomen as far as possible. When this is accomplished it is infiltrated at the site of proposed ligation. It is then transfixed, securely ligated and severed at least $^1/_2$ inch distal to the ligature. It is necessary to make the ligation secure for if the cord bleeds after it retracts the hemorrhage is very difficult to control. After the cord has been removed the inguinal canal and the incision in the scrotum are closed. If there is much oozing within the scrotum it may be well to place a drain at its lowest point. The skin must be infiltrated at the site of drainage before the incision is made.

Hemostasis is the Chief Requisite

By this means the cord can be removed nearly to the pelvic brim. If the pelvic portion of the cord is to be removed, as for tuberculosis, or if the lumbar glands are to be removed, as is advisable for some malignant tumors, general anesthesia must be resorted to.

VASECTOMY.—The section of the vas is done to prevent the propagation of the species. It is now confined to the sterilization of criminals in some states, but the signs of the times seem to indicate that it may soon have a wider application.

The vas being covered only by the skin and the tunics of the cord is easily reached. Grasped by the thumb and finger, either in front or behind the scrotum, it is infiltrated with quinine. The vas is ex-

posed with a few strokes of the knife. The vas is then infiltrated with a few drops of the quinine solution. This is necessary because of the density of the coats of the vas; diffusion is slow and if the vas is not thoroughly anesthetized the patient is apt to feel a sickening sensation when it is severed. A short section of the vas is resected and the ends allowed to retract. If the deferential artery is cut it must be carefully ligated. The tunics of the cord are very vascular and careful hemostasis is required if annoying infiltration of the scrotum is to be avoided. The skin is closed with a suture or two of fine catgut. A small dressing is placed within a suspensory and the patient is allowed to go about his business. The quinine effectually controls the after-pain and if hemostasis is perfect there is no annoyance.

# CHAPTER XIV

## Circumcision

Removal of the redundant foreskin is usually the operation which furnishes the first lesson for the beginner in local anesthesia. Simple as the operation is, careful technic is required in order to avoid many annoyances during its course and afterward.

The foreskin is supplied by the dorsalis penis nerve which enters the dorsum at the root and sends branches which supply both the cutaneous and mucous surfaces.

A rich plexus of veins lies between the skin and mucous surfaces and at the frenulum is an artery which always requires ligation. Smaller and less constant arteries are found on the dorsal or lateral aspects.

Anatomy

The usual error in circumcision is that the skin is anesthetized but the mucous membrane is neglected. The frenulum, too, sensitive as it is, is often overlooked. The skin is too thin to permit endermic infiltration and subdermic injection must be depended upon.

With the foreskin in its normal position a line $^1/_4$ to $^1/_3$ in. wide is infiltrated just back of the corona of the glans (a, Fig. 64). Some care is needed in order that a perfect circle is described.

The foreskin is then fully retracted and a line is injected in like manner in the mucous membrane about $^1/_4$ inch proximal to the corona glandis (Fig. 65) The frenulum is then injected from the line in the mucous membrane to the glans (Fig. 66).

The Frenulum is the Most Sensitive Area

The foreskin is then returned to its normal position and the skin is snipped through with scissors (Fig. 67). The skin alone is cut. The fluid injected raises the skin from the veins and it is possible to

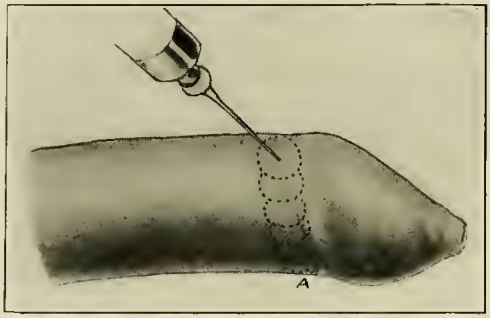



Fig. 64. Line of skin infiltration.

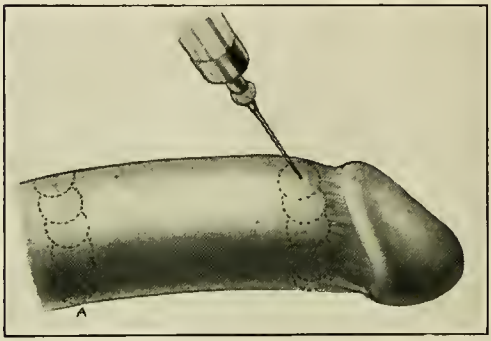



Fig. 65. Infiltration of the inner surface of the foreskin.

sever the skin without cutting the veins. The skin is now snipped from the vessels and subcutaneous tissue until the line of the infiltration in the mucosa is reached (Fig. 68). By this means most of the veins retract with the subcutaneous tissue and are

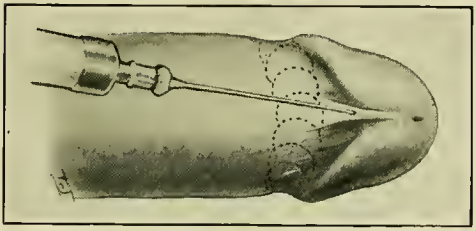


Fig. 66. Injection of the frenulum.

Fig. 67. Incision of the skin.

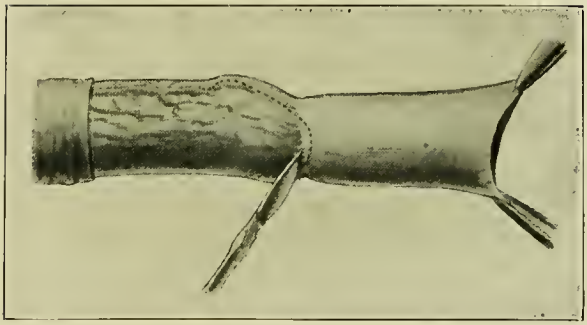


Fig. 68. Dissection of the foreskin from the veins and connective tissue.

not severed. The mucosa is then cut with snips of the scissors about $^1/_4$ inch from its insertion (Fig. 69). The frenulum is cut not more than $^1/_8$ inch from the glans.

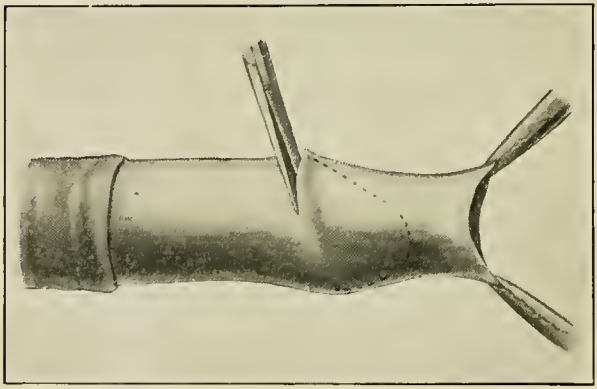


Fig. 69. The mucosa is cut ¼ inch from its attachment.

Fig. 70. Union of skin and mucosa with interrupted sutures.

Careful Hemostasis is Essential

The artery of the frenulum and any other bleeding points are caught up and ligated. Exact hemostatis must be accomplished before suturing is begun. If this detail is not observed oozing in the loose tissue will cause swelling, discoloration and delayed healing. In some instances the hemorrhage

may soak the dressings and be the cause of embarrassment to both patient and operator. The most certain way of securing all bleeding points is to catch them up the moment they are cut.

The mucosa and skin are then united with fine catgut (Fig. 70). The sutures should be placed close together so that there will be no gaping spaces. A little attention to this detail brings a smoother recovery and well repays the extra time spent. A simple gauze dressing completes the operation.

Complication do not arise if hemostasis has been carefully performed. The sutures occasionally become infected but this delays healing for a few days only.

Quinine is the anesthetic of choice, but novocain may be used with satisfaction. If cocain is used a constricting band is placed about the root of the penis to lessen the absorption. This is objectionable in that after the constriction is removed there is apt to be annoying oozing.

It has recently been proposed to block the nerves at the root of the penis. If this method proves successful it should be useful for amputation or extensive cauterization of the glans.

# CHAPTER XV

## Operations About the Rectum

Operations about the rectum under local anesthesia have not been popular with general surgeons but have found favor with patients. Specialists and general practitioners have been more ready to recognize the merits of local anesthesia than have surgeons. The anal region is on the whole the most difficult field for the employment of local anesthesia. Blocking operations, because of the abundant nerve supply from a number of sources, is difficult. The area is exceedingly sensitive and the position of the patient during the operation tends to make the technic difficult. Any apprehensive movement on the part of the patient adds materially to the difficulties of the operator. Nevertheless, when the fundamentals are mastered no other region permits operations of all varieties to be carried out with more satisfactory results to both practitioner and patient. No other class of operations deserves more to be done under local anesthesia. Patients are reluctant to submit to general anesthesia for the relief of a condition which does not endanger life and to the inconvenience of which they have by degrees learned to submit with more or less patience. Only when actually incapacitated do they readily submit to radical operations under general anesthesia. The result of reluctance of the general surgeon to employ local anesthesia has been to drive sufferers from piles to the advertiser, who has been more ready to accede to the demand for

relief without general anesthesia. The general practitioner can prevent the defection of his patient if he will do these operations under local anesthesia. Most of the rectal diseases belong to the domain of minor surgery and should be quite within the province of the general practitioner. Certainly any man who can repair a recently lacerated perineum should be able to carry out nearly all the operations upon the rectum after he has once mastered the rudiments of anesthesia as applied to this region.

*Anatomy.* A knowledge of anatomy is a necessary preliminary, and that not alone of the nerves but also of the muscles and vascular supply; for nowhere else can complications affecting these tissues be more certainly avoided by anticipating them.

Anatomical Considerations

Broadly speaking the region in question consists of the termination of the gut canal, the group of muscles surrounding it and the associated vessels and nerves. The external sphincter, an elliptical muscle surrounding the outlet, is the most important muscle. Above it is the internal sphincter, which is merely a reinforcement of the circular fibres of the rectum. The integrity of these muscles must be retained lest an embarrassing incontinence result. Descending from above in the submucous layer are the hemorrhoidal arteries and veins. It is from these vessels that post-operative hemorrhage may occur if the technic has been faulty. The vessels which approach the anal region through the perirectal space are readily seen during the operation and are as readily controlled. The nerve supply, on the other hand, is chiefly found in the perirectal space. Appearing from either side slightly behind the anal axis are the long perineal nerves and from the depth

supplying the lateral and anterior portions are the hemorrhoidal nerves. The coccygeal nerve approaches from behind (Fig. 71). Descending from above within the wall of the gut are branches of the sympathetic nerve. These like sympathetic nerves

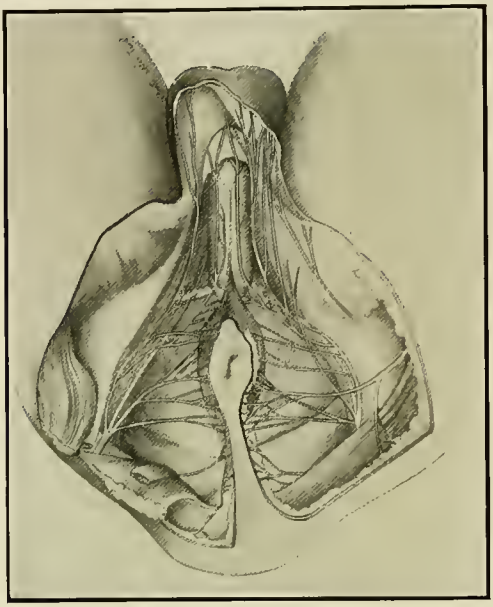


Fig. 71. Nerves about the rectum.

in other regions of the intestinal tract are sensitive to traction. None of these structures is surgically fastidious yet they demand a certain respect if the surgeon's relations in his dealings with them is to be at all times agreeable and harmonious.

Types of Operation

Operations about the anus may be divided into those which may be done without dilatation of the sphincter and those in which dilatation is a necessary

preliminary. In the former class are ischio-rectal abscesses, cutaneous and mixed piles and palliative operations upon prolapsed internal hemorrhoids. Those demanding a preliminary dilatation of the sphincter are internal hemorrhoids, fistulas, fissures and all tumors within the gut. Although prolapsed internal piles may be operated without dilatation, there is most certain to be some that have remained internal to the sphincter which will likely give rise to trouble at some future date and a recurrence after operation is likely to be recorded against the efficiency of surgical treatment. Therefore, even if one pile is prolapsed and easily within reach of ligation without dilatation, the sphincter should be stretched in order that all hidden nodules may be reached. Furthermore, if the prolapsed pile is so operated the pedicle slips back within the sphincter and should hemorrhage occur it is almost certain to be undetected for a long time.

EXTERNAL HEMORRHOIDS.—This variety is formed by the coagulation of blood within the veins of the anal region. They are covered by skin not materially changed or at most but slightly inflamed. When the thrombosis extends into the veins of the mucous surface, a mixed variety, the mucocutaneous variety is obtained. If the submucous veins are extensively involved a prolapsed internal pile may be diagnosticated.

Skin Infiltration

If the tumor is confined to the cutaneous surface and the skin over it is but slightly or not at all involved a line may be infiltrated over its surface (Fig. 72). A simple incision is made into its substance and the clot turned out. A suture may be placed to control the bleeding; this may be removed after a day or two and healing by granulation

permitted. In some instances the mere compression by a tampon for a few minutes controls the bleeding and a suture is not necessary.

If the skin over the pile is much inflamed or if the thrombus extends into the mucous membrane it is

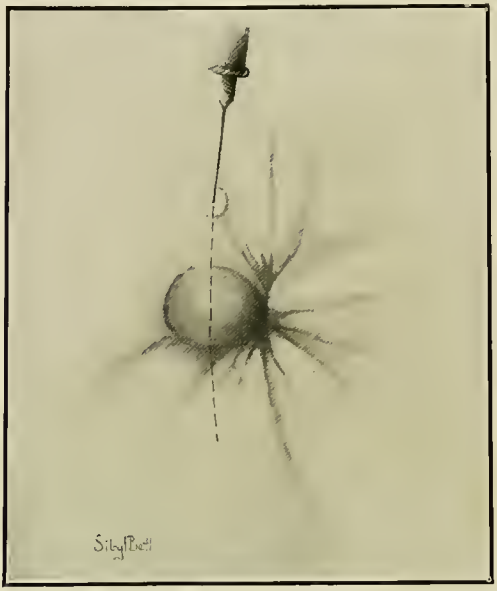


Fig. 72. Infiltration over surface of cutaneous hemorrhoid.

better to infiltrate the normal skin about the tumor (Fig. 73), circumscribing the painful area. Deep injections beneath the tumor are also necessary. Incision may then be made into the mass and the clots turned out; or, better still, a flap of skin and mucous membrane may be raised up, and the venous mass ligated and dissected out. The edges of the flap may then be approximated by a few sutures. Infiltration

of the mucous surface may be painful and the comfort of the patient is much enhanced by a previous topical application of cocain or novocain in 2 per cent. solution, or quinine in 10 per cent. solution. Water as hot as can be borne for a few minutes likewise makes manipulation less painful. These ad-

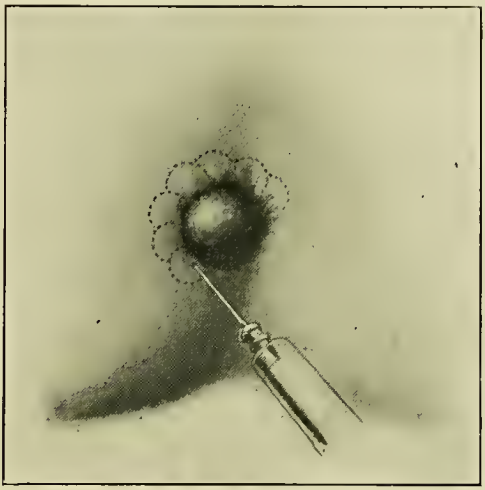


Fig. 73. Inflamed muco-cutaneous pile showing line of infiltration in the normal skin about the tumor.

ditional attentions to the patient's comfort are quite well worth the time expended, particularly to the operator of limited experience.

For prolapsed internal hemorrhoids, the cutaneous border is infiltrated as above; and infiltration of the base of the tumor either with or without preliminary topical anesthetization (Fig. 74) is sufficient to permit painless transfixion and ligation of the piles. The undesirability of removing the prolapsed pile

alone has been sufficiently emphasized; but in many instances the practitioner and patient are satisfied with the relief the removal of the chief offender affords and are willing to risk the mischief its less conspicuous fellows may produce at a later date.

OPERATIONS WITH DILATATION OF THE SPHINCTER.

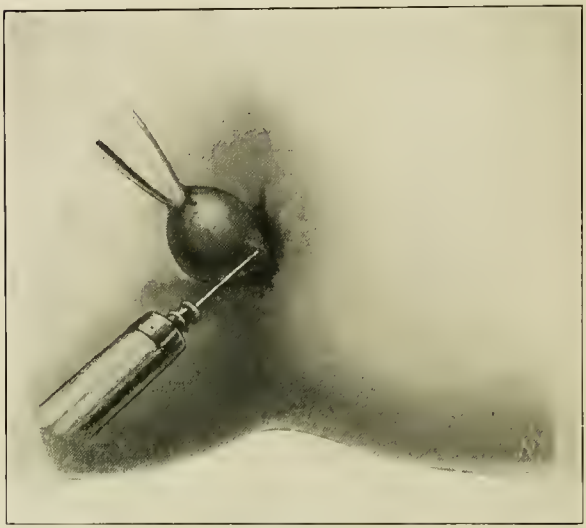


Fig. 74. Prolapsed internal hemorrhoid. The skin has been infiltrated as in Fig. 73, and the base of the pile is being infiltrated.

—INTERNAL HEMORRHOIDS.—Operations demanding a preliminary dilatation of the sphincter may well be divided into two steps, the dilatation and the operation itself.

Infiltration of the Sphincter

In order to dilate the sphincter it must be anesthetized and to reach the sphincter the skin must first be anesthetized. This is most conveniently done by infiltrating a circle about the anal margin (Fig. 75).

Beginning at the most convenient point over the coccyx a semi-circle is described on one side and then beginning at the original point the opposite side is infiltrated, the two lines meeting in the raphe in front of the anus. A needle now is thrust into the substance of the sphincter at the four points marked

Fig. 75. A line of skin is infiltrated about the anal margin over the sphincter.

in Fig. 5. A needle of sufficient length actually to penetrate the muscle must be employed. A finger introduced within the anus will assist in guiding the needle to the proper depth in order to infiltrate the sphincter (Fig. 76). The mucous membrane of the anus may be anesthetized by placing a small pledget saturated with a 10% solution of quinine or a 4% cocain solution within the grasp of the sphincter.

By the time the skin about the anus has been infiltrated the finger may be introduced painlessly. I ordinarily omit this procedure, for usually the in-

Fig. 76. The needle is shown passed to the proper depth to infiltrate the sphincter.

filtration of the sphincter permits the finger to be introduced without pain if it is done gently; and after the sphincter is infiltrated the mucosa is usually

anesthetized. If not, injections into the submucosa may be made from within the anal margin. The process of dilatation is facilitated by a special perineural blocking of the coccygeal nerves by depositing a syringe full of fluid immediately in front of the tip of the coccyx.

Dilatation of the Sphincter

The dilatation of the sphincter may now be commenced. The index finger is placed well within the sphincter and is followed by the same finger of the opposite hand. Traction may now be applied until the desired relaxation is obtained. It is worth while to take plenty of time to secure sufficient relaxation for permanent improvement is more likely after a slow operation than when the manipulation is done brusquely. Ordinarily a moderate degree of dilatation is sufficient, particularly if the operator is experienced in this class of operations.

Infiltration of the Pedicle

When the sphincter is dilated the pile nodules are sought and fixed with forceps. Not infrequently traction on the pile causes pain, due to stretching the sympathetic filaments coming down from above. This may be readily controlled by the injection of the pedicle above the proposed site of ligation (Fig. 77). The operation may now proceed in the usual manner. The method I prefer is ligation performed by passing a threaded needle eye-end first through the pedicle (Fig. 78). The ligature is tied without first incising the mucous surface as usually recommended. The larger vessels descend from above and are effectually controlled by this method. The redundant portion may then be excised and the edges of the mucosa united by sutures. The usual method of forming a pedicle is to incise the mucosa above and doubly ligate the pedicle so formed. In many recent cases the mucosa may be elevated, the

Incision of the Pile

pile isolated and the pedicle ligated and the flap replaced and united with sutures. The number of masses which require ligation varies. Usually one on each side slightly behind the center and one anterior corresponding to the site of chief blood sup-

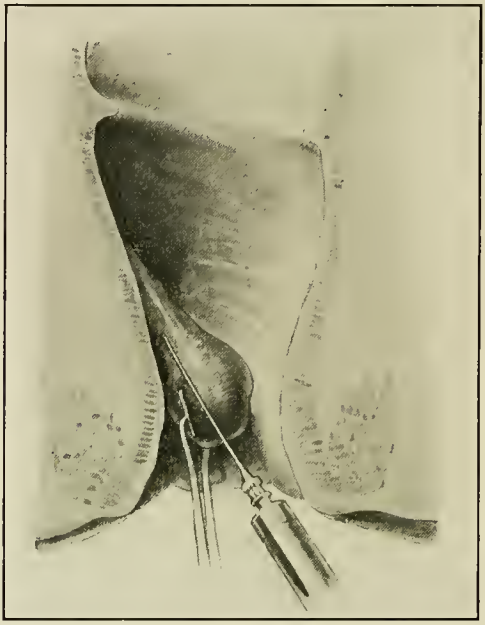


Fig. 77. Traction is made upon the pile and injection is made directly into the pedicle.

ply, will be sufficient. As few pile masses as possible should be ligated in order to lessen the liability to stricture.

If tags of skin remain they may be excised and the edges loosely approximated with fine catgut.

The cautery may be employed, but care must be exercised lest the heated instrument come too close to

the thigh or the buttock. The hissing sound produced by the cautery is apt to produce a disquieting effect upon the patient and the transmitted warmth to unanesthetized areas is apt to excite unpleasantly his apprehension.

There is no after treatment. Quinine properly employed gives anesthesia which lasts for several

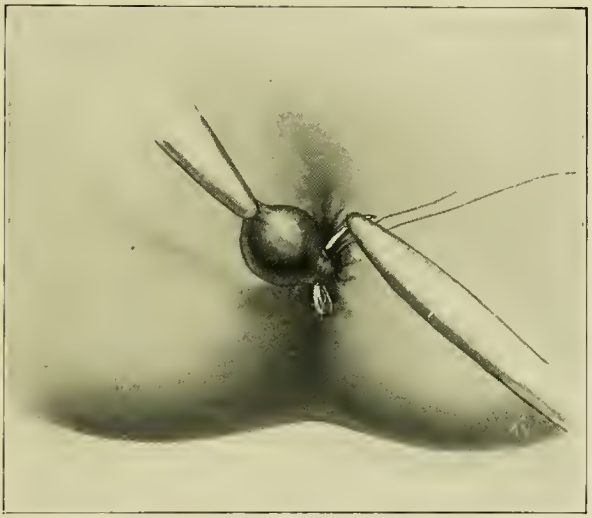


Fig. 78. The needle is passed eye-end first through the pedicle.

days or until healing is well established. The skill exercised in making the infiltration and in dilating the sphincter determines the after course. If the amount of fluid is excessive and a large amount of exudate is produced a sense of fullness may be felt in the rectum. This may be so great in some instances as to interfere with a free movement of the bowels, according to the patient's view. This is only temporary and disappears in a week or two, but

resulting in perfect resolution. The patient's mind is set at ease if this result is explained to him. Gauze packing is not used except in Christian Scientists to whom pain is but a figment of the imagination.

FISTULA IN ANO.—The radical cure of anal fistula can be accomplished with surprising ease under local anesthesia. My own preference is for an excision of the fistula with the immediate closure of the fistulous tract. Many still prefer the simple incision and for the beginner this is certainly the operation of election.

*Incision of the Fistulous Tract.* This operation merely aims at conversion of the fistula into an open wound which shall be allowed to heal by granulation. If the internal opening is within the sphincter the operation may be done without a preliminary stretching of that muscle. If it ends high within the gut the sphincter must be dilated.

The skin about the opening (Fig. 79) and a line from this point to the anal margin and up the mucous surface to the opening of the tract within the gut are infiltrated. Injections are then made in the deeper portions along the line of the fistula and anal sphincter, and then in the tissue about the fistula (Fig. 80). An incision is then made down to the director within the tract. Should the tract lead beyond the external sphincter the operation must be interrupted in order to infiltrate the deeper portions of the gut. Bleeding points should be picked up and ligated. A tampon should not be depended upon to control the bleeding. The bottom of the tract should be incised to permit new granulations to develop; the wound is loosely packed with gauze and allowed to granulate. This operation gives

**The Bottom of the Tract Must Be Incised**

good results in simple straight fistulas though from 4 to 8 weeks are required for healing to take place.

*Excision of the fistulous tract.* The operation of choice in anal fistula is the excision of the tract or tracts and the immediate suture of the wound. It is true the method sometimes fails; but results will be secured in 90 per cent. of cases and should infection

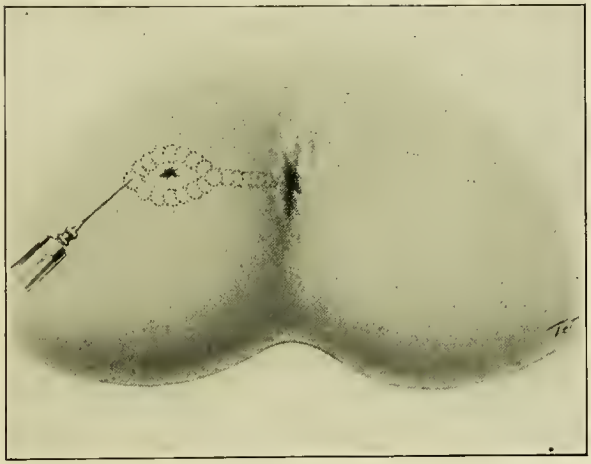


Fig. 79. A line is infiltrated about the fistula and extending to the anal margin.

take place healing by granulation follows and nothing has been lost. If successful, healing is complete in a week or two as after the repair of a lacerated perineum.

If the tract is high or complicated the sphincter should first be dilated as already described.

**Dissection of the Tract**

The fistulous tract is then infiltrated as for the simple operation by incision. A grooved director is passed through the tract and the fistulous tract dissected out using the director as a guide (Fig. 81).

The tract should be removed as an intact tube. If inadvertently cut into infection will be liberated. It may be well to inject the tract with tincture of iodine before the operation is begun if the operator is not sure of his skill in removing it intact. If the

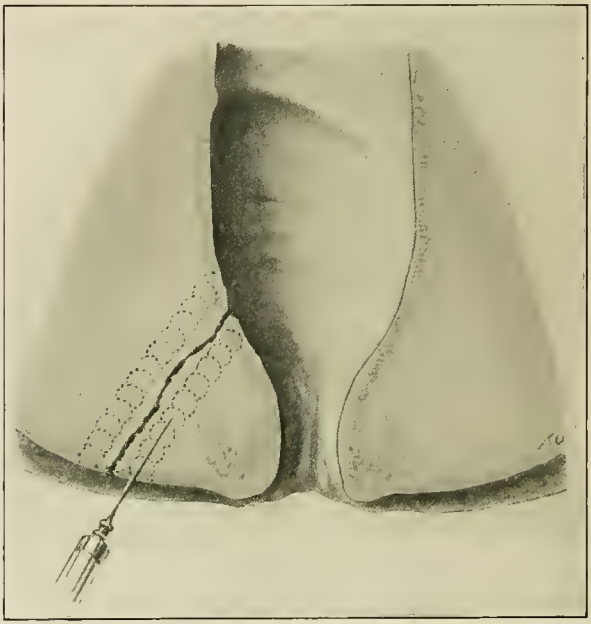


Fig. 80. The tissue about the fistula is infiltrated throughout its length.

opening in the gut is high up the cut edges of the gut must be grasped lest they slip beyond reach and bleeding points cause embarrassment.

Closure of the Tract

The tract being removed and all accessory tracts attended to in like manner, closure of the wound is begun by suturing first the incision in the gut. In-

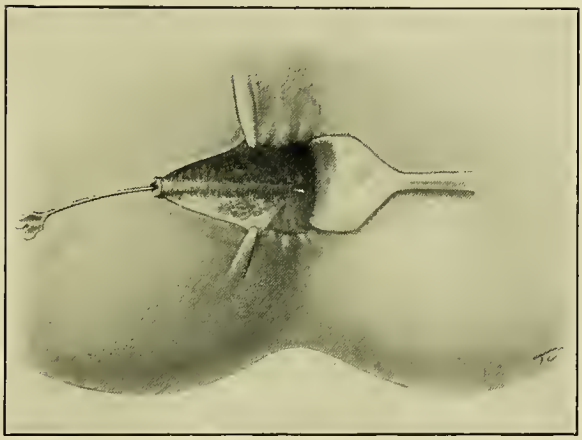


Fig. 81. The fistulous tract is dissected out intact.

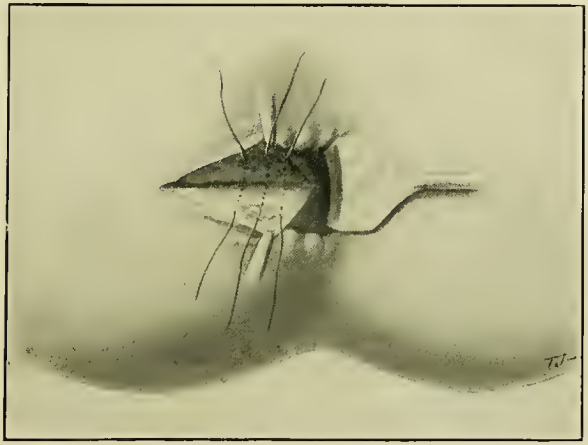


Fig. 82. Buried sutures of catgut placed through the severed ends of the external sphincter.

terrupted sutures of catgut are used and as the gut is closed it is allowed to retract into its normal position. The deeper portion of the wound is closed by buried catgut sutures (Fig. 82) after which silkworm sutures are used to close the skin (Fig. 83).

The rectum is lightly packed with gauze to protect the line of suture as much as possible. The bowels

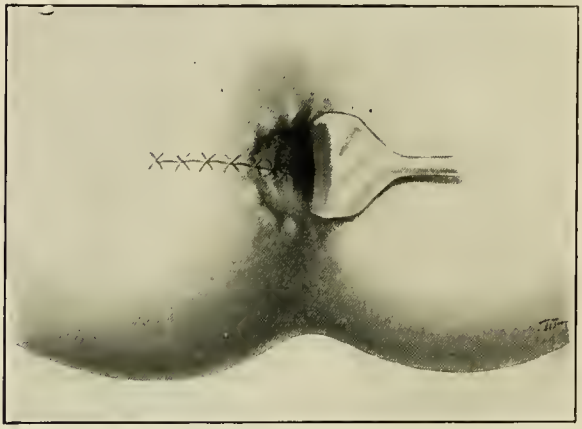


Fig. 83. Deep silkworm sutures close the skin. Catgut in the lumen of the bowel.

are kept locked with opium for four days and are then moved by a combined laxative and enema.

A number of difficulties may be encountered in this operation. If there is much scar tissue great care is necessary to infiltrate the surrounding parts, for scar tissue is sensitive to operation and is too dense to be infiltrated. The accessory tracts may be difficult to find. Usually they extend about the anus horseshoe-fashion between the sphincter and skin. If the internal opening cannot be found great care must be exercised to find the highest point of the

If the Tracts Are not All Excised, Failure Results

tract before an opening is made into the gut. The operator should not delude himself into thinking that he can cure his patient without an internal opening and the division of the gut. Should suppuration of the wound take place the sutures must be removed from the infected part. It is very rare indeed for the entire wound to require opening.

FISSURES OF THE ANUS.—Fissures which do not yield to simple cauterization should be treated by sphincter dilatation and excision.

The dilatation of the sphincter is done as previously described. This likewise produces anesthesia about the fissure. A V-shaped incision is made to include all the fissured area. If there be bleeding it is controlled by ligation. The wound may be closed by suture or allowed to heal by granulation. The decision depends upon the size and location of the fissure.

## CHAPTER XVI

### Repair of the Cervix and Perineum

Nerve Supply

Laceration of the cervix.—The cervix is supplied by sympathetic nerves by way of the broad ligaments. It is but little sensitive as is readily

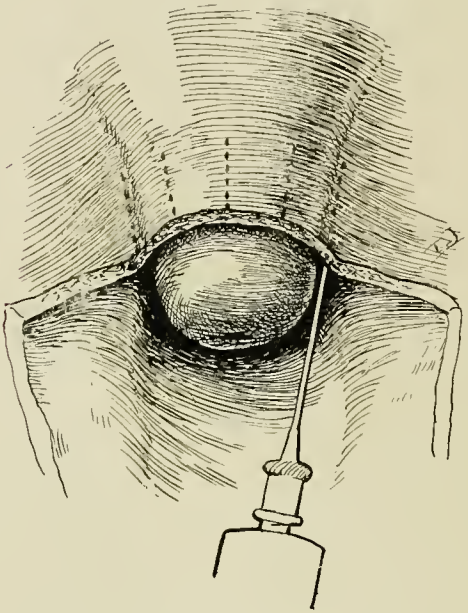


Fig. 84. Infiltration of tissues about cervix.

demonstrated by the common practice of grasping it with a tenaculum forceps when making ordinary office examinations.

The cervix is exposed by a suitable perineal retractor, fixed with a tenaculum and drawn down as

near as possible to the vulva. The base of each broad ligament is infiltrated as high as the internal os. This is done by passing the needle close to but not into the uterine musculature (Fig. 84). Several syringefuls should be injected on each side. The space between the cervix and bladder is then infiltrated at three or more points. Similar points are injected posterior to the cervix.

Anesthetization

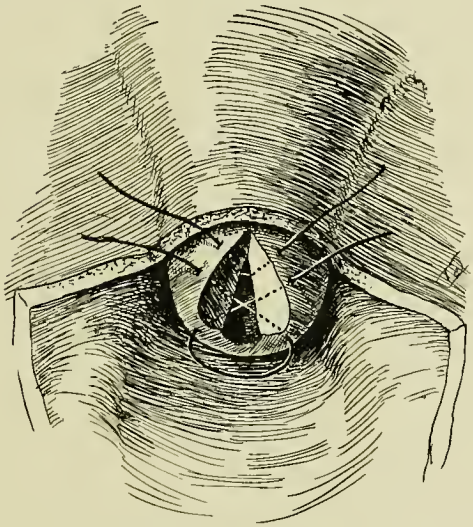


Fig. 85. Figure-of-8 suture closing wound in cervix.

A wedge of tissue corresponding to the depth of the tear is removed by means of a knife. Enough of the cervical mucosa is allowed to remain to insure the integrity of the canal.

The Incision Must Be Complete

A suture is placed at the upper angle of the incision. Care must be taken that the suture includes all the freshened surface; otherwise a bleeding vessel may escape. The remainder of the incision

The Sutures Must Control the Hemorrhage

is then closed by a figure-of-8 suture or by interrupted sutures (Fig. 85). The figure-of-8 suture is more difficult to place but gives a better shaped cervix as it prevents the conical point which is apt to be formed when interrupted sutures are used, particularly when the amount of tissue removed has been large (Fig. 86).

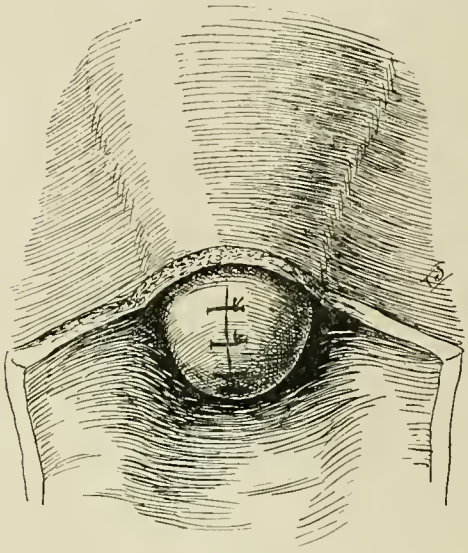


Fig. 86. Cervix, repair complete.

CURETTAGE.—After the anesthetic has been injected as above described the cervix may be dilated. If after dilatation it is desired to curet the uterus the interior of its cavity should be packed with a strip of gauze saturated with a 10% quinine or a 4% cocain solution for five or ten minutes. Curettage may then be carried out.

REPAIR OF THE PERINEUM.—The repair of the

perineum may be accomplished readily under local anesthesia, but because of the time required and the inconveniences it imposes upon the operator this operation will likely be restricted to those cases in

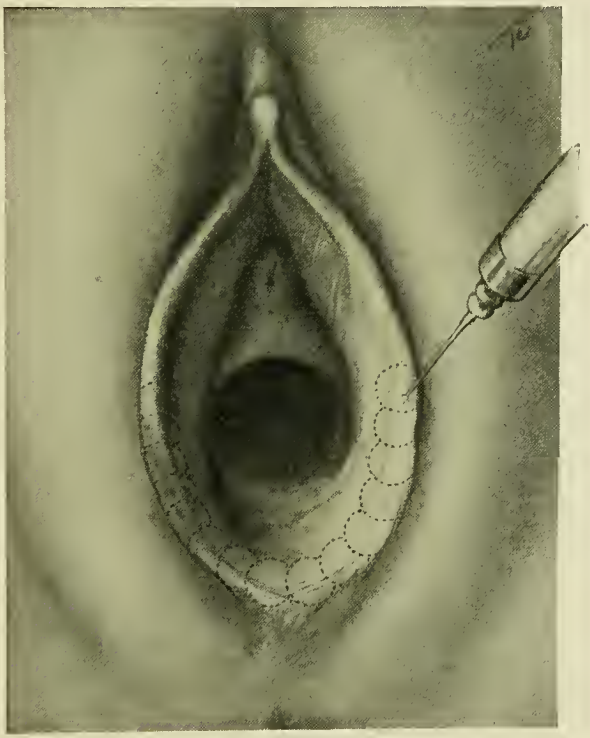


Fig. 87. Preliminary infiltration.

which there is a contra-indication to general anesthesia or where the operator is without available assistance.

The area involved in the repair of the perineum resembles closely that involved in the operation for

Nerve Supply

anal fistula. The nerves being derived from many sources dependence must be placed upon infiltration rather than upon perineural blocking.

A line is infiltrated beginning at one caruncle and

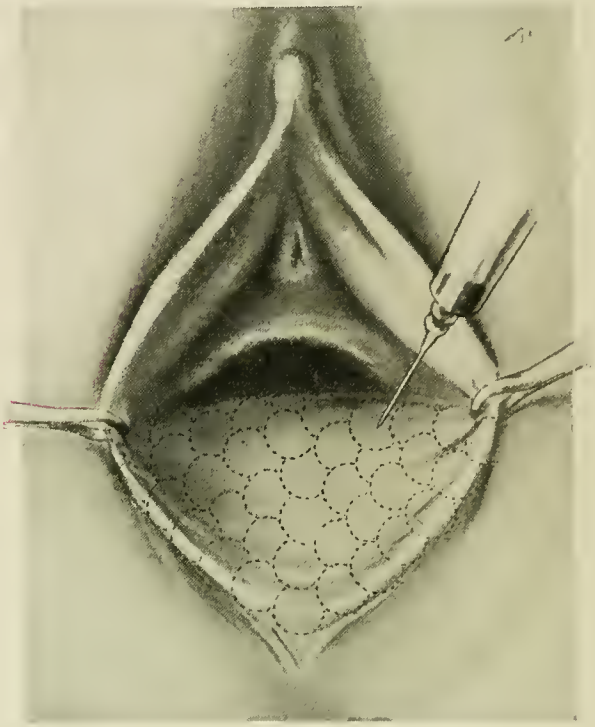


Fig. 88. The entire area to be denuded is infiltrated.

Superficial Infiltration

passing along the mucocutaneous junction to a like point on the opposite side (Fig. 87).

The region of each caruncle is grasped with tenacula and moderate traction is made. This exposes the extent of the laceration. A line is now infil-

trated from each caruncle to the highest point in the laceration. The triangle so described is infiltrated by a liberal injection of fluid between the vaginal and rectal walls (Fig. 88).

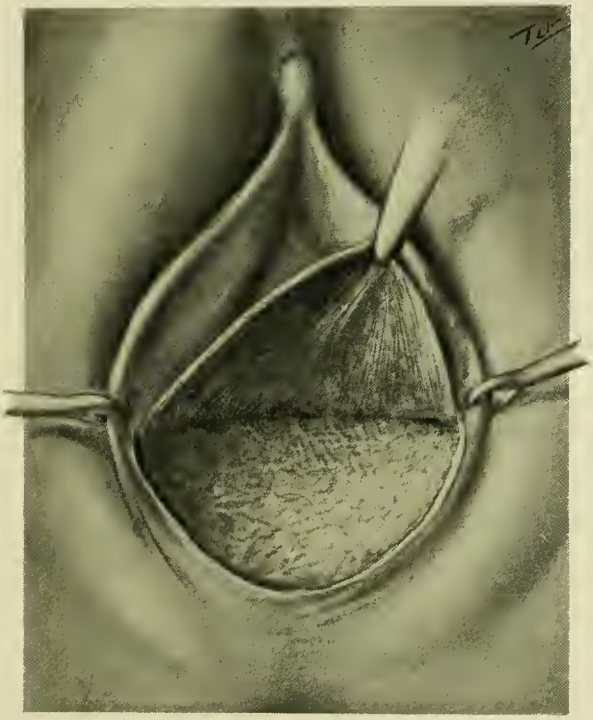


Fig. 89. The vaginal flap is elevated.

A deep injection is now made outward and backwards from just below each caruncle. This should infiltrate the levator muscles which are subsequently to be united. The injection should reach well beyond the region through which the suture is to pass.

Deep Infiltration

An incision is now made along the line of the first infiltration and the mucous membrane of the vagina is elevated from the rectum as far as the infiltration has been made (Fig. 89).

Fig. 90. Isolation of the levator ani muscle.

Isolation of the Levators

The levator is now located. Usually it can be found by thrusting the finger into the loose tissue, but if necessary the tissue may be incised with a knife. The muscle when isolated is drawn forward

upon the tip of the finger and the suture passed through it (Fig. 90). The opposite side is treated in like manner and the two sides are then brought together with a number of sutures (Fig. 91).

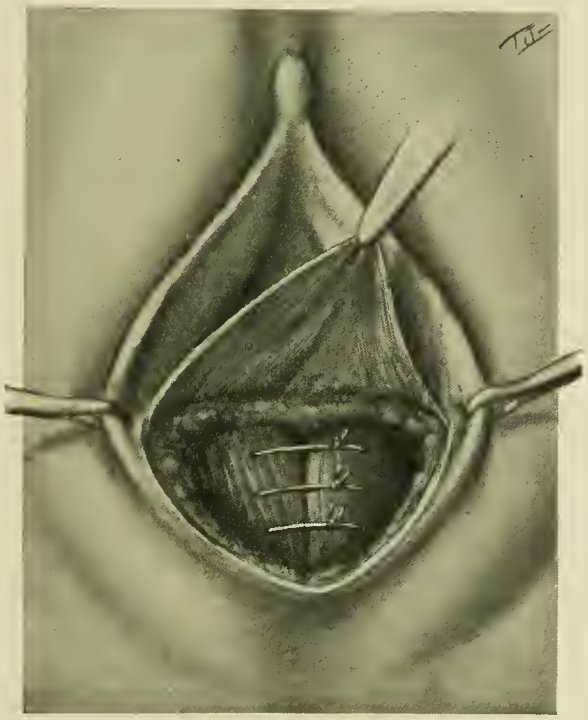


Fig. 91. The muscle on the opposite side is isolated in like manner and the two united.

The deep perineal fascia is now united by a separate plane of sutures (Fig. 92). This layer covers the sutures in the levator muscle and furnishes the chief support for the perineum.

The triangle of the posterior vaginal wall is now

trimmed off as may be required and a running suture applied the entire extent of the wound remaining (Fig. 93).

Care should be used in performing this operation

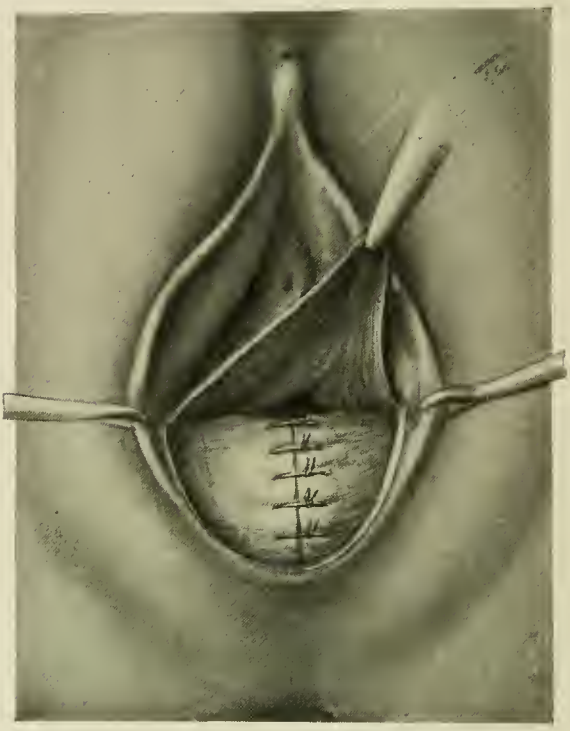


Fig. 92. The deep perineal fascia is united by a separate row of interrupted sutures.

that no more than necessary of the anesthetic solution be injected into the tissues through which the sutures are to pass in order to avoid making the tissue edemic. If the tissues are saturated with fluid

the condition is similar to that existing immediately after labor and must be met by the same modification in technic—the sutures must be drawn more tightly

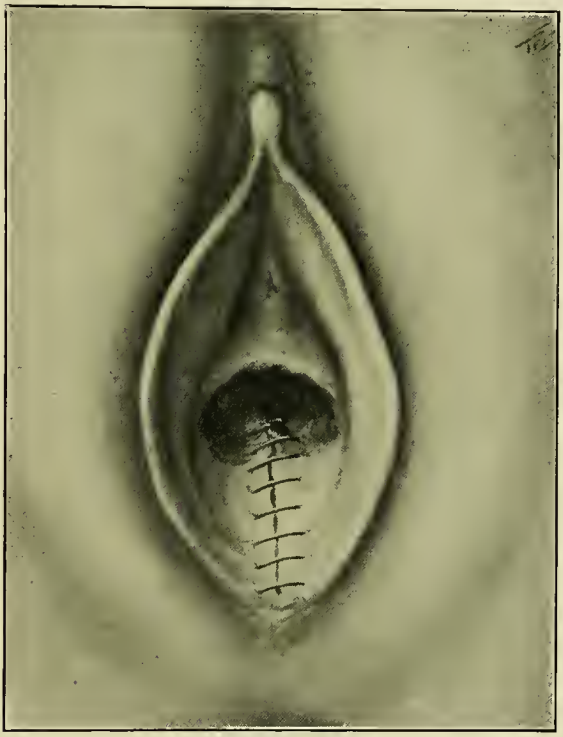


Fig. 93. The edges of this vaginal and cutaneous incision are united with a running suture.

so that the tissues are still held in apposition after the fluid is absorbed. For the deep sutures chromic catgut should be used.

# CHAPTER XVII

## Operations Upon the Extremities

THE HAND AND ARM.—Most lesions on the hand may be treated under local anesthesia as the method of election, infiltration or perineural blocking being usually employed. Major amputations of the hand

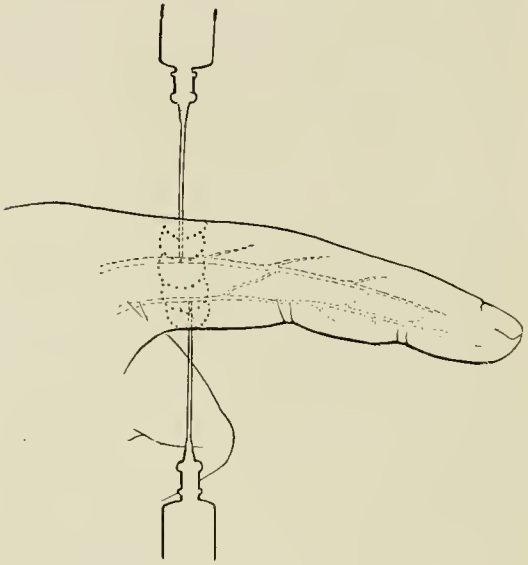


Fig. 94. Injections about finger into region of digital nerves.

Limitations of Local Anesthesia

and arm may be done under local anesthesia if there is a contra-indication against general anesthesia. Simple infections may be satisfactorily treated under local anesthesia, but the severe infections involving the tendon sheaths demand a general anesthetic.

Local infections of the fingers may best be opened by perineural blocking. A line of skin is injected about the finger proximal to the infection. After this several deep injections are made in the region of the digital nerves (Fig. 94). The incision should be painless. If the infection is local, infiltration about it may suffice. Quinine is the preferable agent since it controls not only the pain at the time of the incision but also the after-pain, so that the burning which usually follows the incision of such lesions is absent.

This method is recommended for infections confined to the fingers, or abscesses of the dorsal or palmar surfaces of the hand which are known to be localized. Abscesses extending from either the thumb or little finger and invading the common tendon sheath demand a general anesthetic, for in such instances wide areas demand incision, extending well up the tendon often to the palm of the hand or even to or above the annular ligament of the wrist.

TUMORS.—Papillomas are common lesions of the hands. Usually less heroic measures are employed but in some instances excision is demanded. The deposition of a few drops of the anesthetic solution below their base makes it possible to excise them painlessly. Either the cocain or the quinine solution secures satisfactory results either for immediate excision or for cauterization.

The arm, particularly in the region of the shoulder is a common seat of lipomas. They seldom reach large size. They are much rarer about the hand and are sometimes found in the tendon sheath. If large, particularly if pedunculated, the base may be excised by elliptical incision after endermic an-

esthetization of the skin and edematization of the loose tissue about and beneath the tumor. It is well to give time enough for a careful anesthetization because at the base of the tumor are usually vessels of importance and the catching up and ligation of

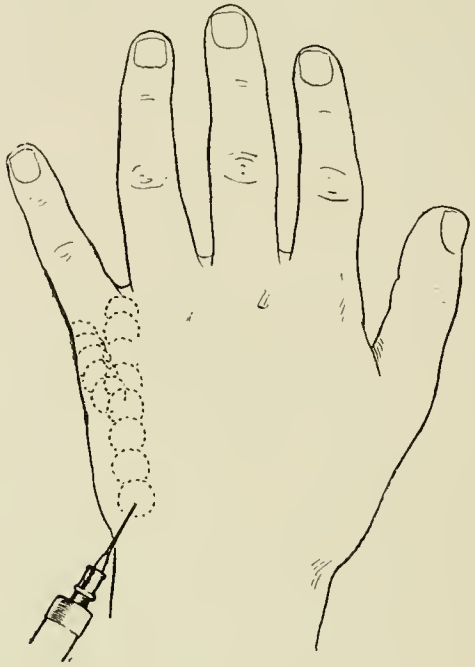


Fig. 95. Removal of metacarpal. Skin infiltration.

these cause pain unless anesthetization has been thorough.

Ganglia usually affect the tendons on the back of the hand. They are readily removed by making a linear infiltration over their summit and following this by infiltration of their sides and base. Because

of the desirability of a reactionless healing and because only a small amount of fluid is required cocain is the desirable anesthetic for this purpose. Because the tendon sheath is exposed in this operation the most painstaking asepsis must be observed.

Needles and splinters furnish frequent demands for operative interference. These little operations, apparently simple, are notoriously deceptive and may require extensive search before the object is recovered. It is well, therefore, to anesthetize a considerable area about the site of entrance. This may be done by endermic followed by subcutaneous injection. The site of foreign bodies is most often the palm of the hand where the skin is highly sensitive and firm. Often pain may be spared the patient by passing the needle along the tract made by the foreign body until the subdermic tissue is reached and this region may then be infiltrated.

X-Ray Picture is Desirable

In small incised wounds the use of stitches is only slightly painful and unless several are required a local anesthetic is unnecessary; but if one should be needed, injection about the base of the finger followed by perineural blocking may be employed. This method is to be used when there is extensive hemorrhage or when tendons have been severed and require suturing. With the anesthetization of the entire finger the wound may be enlarged if necessary to secure a bleeding point or to locate a divided tendon. If the injured tendon is in the palm or dorsum the skin is infiltrated for several centimeters in each direction from the wound parallel with the divided tendon. This done an incision is made over the divided tendon and the ends caught up and approximated by means of forceps. They are retained in this position by means of fine silk sutures. The

skin is then closed unless infection is suspected in which event drainage is indicated.

AMPUTATION.—Phalanges are easily exarticulated under local anesthesia. The finger is anesthetized

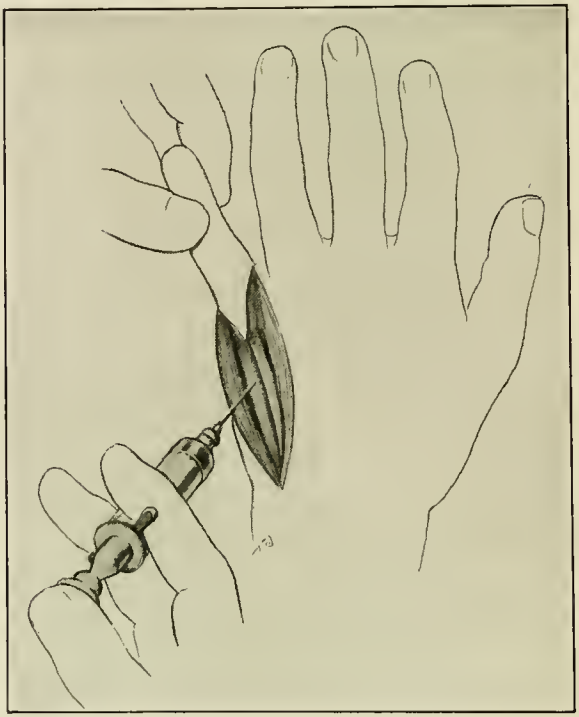


Fig. 96. Periosteal infiltration in metacarpal amputation.

by circular injection and perineural blocking. If a bone is to be severed injections into and about the periosteum must be employed. By this means anesthesia may be produced so that the phalanx may be cut or sawed without pain. If a metacarpal bone

is to be removed in whole or in part the region must be circumscribed by the anesthetic (Fig. 95 and 96). It is possible by this means to isolate the object of attack.

Major amputations of the hand or arm have been repeatedly done under local anesthesia; but it may well be reserved for those instances in which a contra-indication to general anesthesia exists. The method to be followed is briefly as follows: a circle of skin is infiltrated about the entire circumference of the arm at a point above the site of amputation where large nerve trunks are the most accessible

General Anesthesia is Preferable

Fig. 97. Amputation of arm. Skin infiltration and nerve blocking.

(Fig. 4). Beneath this circular line the subcutaneous tissue is infiltrated in order to block subcutaneous twigs which may go to the skin in the field of operation. Starting from the circular line of infiltration longitudinal lines over the large nerve trunks are infiltrated. The tissue beneath this line is infiltrated down to the nerve. The nerve is then exposed and an injection is made directly into its substance (Fig. 97). The skin wound made to reach the nerve may then be sutured. If the technic has included all the nerves leading to the part the operations upon the extremity may be carried out without pain. Much judgment is required to perform these operations with satisfaction. If the nerve exposed

seems too small for a main trunk a search may reveal the fact that the nerve divided higher up than usual and that but a portion of it was injected. The larger cutaneous nerves in the region must be kept in mind and an effort made to inject them separately rather than to trust to perineural blocking for their anesthetization.

FRACTURES AND DISLOCATIONS.—The judicious use of a local anesthetic may often lessen the patient's suffering materially. In fractures the general principle may be followed of injecting several syringes full of the anesthetic in the region of the fracture, anesthetizing the periosteum of each fragment. The amount of fluid used must depend upon the size of the bone injured. Not only is the reposition of the fragments painless but the after-pain is controlled. In dislocations the indications are to lessen the spasm of the muscles making reposition easier. Several syringefuls of the anesthetic are injected into the cavity of the joint and several into the tendon of the muscle most constricted. The only objection which may be urged against this method is the possibility of introducing sepsis. A careful sterilization of the skin with iodine and the employment of a solution which may be sterilized by boiling reduce the possibilities to the minimum. Novocain has been generally used for this purpose. No experimental studies have been made with quinine to determine if there is a possibility of producing an excess of fibrin within the joints or about bone fragments.

THE LOWER EXTREMITY.—Puncture of the foot, particularly the sole, by nails or other foreign bodies is one of the most frequent surgical lesions encountered by the general practitioner. The fre-

quency with which tetanus follows these injuries makes their proper treatment of the greatest importance. In fresh wounds it is imperative that the entire tract be exposed immediately and that the entire area which came in contact with the foreign body be thoroughly cauterized and the wound packed. This procedure demands a careful anesthesia. If the wound be clean the needle may be entered in the tract of the foreign body and the infiltration begun in the subcutaneous tissue. This method saves a preliminary puncture of the thick and sensitive skin but it is open to the objection that infection present in the wound may be carried to the deeper structures. Some idea of the depth and direction of the puncture must be obtained from the history of the injury in order that an area large and deep enough may be infiltrated. Anesthesia being completed the tract is laid open with a knife, care being taken to reach the deepest recesses of the wound. The direction of the incision should be parallel with important vessels and tendons. When the wound has been freely laid open hemostasis is secured by ligation or packing and the entire wound is swabbed out leisurely with tincture of iodine. Following this the wound is packed loosely with gauze for a day or two, and may then be allowed to close.

Wounds already infected can usually be satisfactorily opened under local anesthesia provided no joints are involved. The infiltration must be begun in healthy skin and the infected area gradually approached or circumscribed, depending on the degree and character of the infection. Infections following the tendon sheath like those of the tendon sheaths of the hand demand general anesthesia,

Fig. 98. Infiltration of the nail.

Fig. 99. The soft parts are excised and the extent of nail to be excised is indicated.

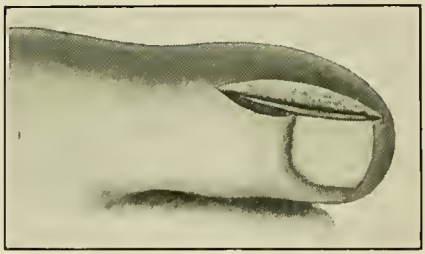


Fig. 100. Same as Fig. 6, with nail removed showing extent of wound.

Injuries to the tendons may be managed upon the same plan as that given for the tendons of the hand.

Ingrowing nails, almost exclusively of the great toe, may be satisfactorily treated under local anesthesia. The object to be attained is the removal of the offending portion of the nail together with its bed in order that it may not reform. Anesthesia is secured by beginning at a point midway between the joint and nail (Fig. 98). A line is injected along the soft parts outside the nail representing the base of the overhanging soft parts (Fig. 98). This is continued until the extremity of the toe is reached. The space beneath the nail is then infiltrated by beginning at the distal end of the nail and proceeding to its base (Fig. 98). After the lapse of a few minutes complete anesthesia will have been obtained.

Next, a wedge of tissue is excised including the overhanging soft parts and the edge of the nail from the tip of the toe to well beyond the root of the nail (Fig. 99 and 100) and down to the periosteum (Fig. 101). The incision must extend far enough back to include all the nail bed lest the portion of the nail reform; but it should not extend far enough to open the joint. When the wedge of tissue is removed the bleeding cavity is firmly packed in order to control hemorrhage. After a time, usually 5 or 10 minutes, this packing is replaced by looser packing. After a few days the wound can with advantage be dressed with Balsam of Peru.

Because of its long duration quinine is distinctly the anesthetic of choice for this operation.

Instead of the method above described a circular line about the base of the toe may be injected and other nerves leading to the diseased area blocked by

deep injections at the base of the toe as shown for operations on the fingers.

Varicose dilatations of the veins of the leg are frequent objects of treatment. Operation is often refused because these patients are often fleshy persons of advanced years little disposed to enter a hospital. Local anesthesia may be employed with satisfaction though it must be admitted that the technic is tedious and time consuming. Careful judgment must be exercised as to the site and ex-

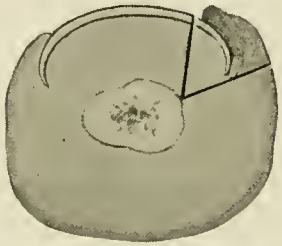


Fig. 101. Cross section of a toe showing depth of wedge removed.

tent of the veins to be removed. This having been determined the veins are made more prominent by placing a constrictor proximal to the site of the proposed operation. The skin is infiltrated over the vein for the required distance (Fig. 102). Injections on either side of the vein may be made though this is not necessary since the tissue within which the veins lie is only slightly sensitive. After infiltration the skin is incised and the vein exposed. The proximal end is doubly ligated and severed. As much as desired of the vein is dissected out and again ligated. Any number of segments may be removed in this manner.

VARICOSE ULCERS.—The excision of varicose ulcers

is unsatisfactory under local anesthesia. Careful infiltration about the ulcer does not anesthetize the sensitive periosteum and the use of anesthetics by application is unsuccessful because of the dense character of the granulations. Varicose Ulcers

TUMORS.—The tumors of the lower extremities which can be satisfactorily removed under local anesthesia are not numerous. Melanomas, papillomas

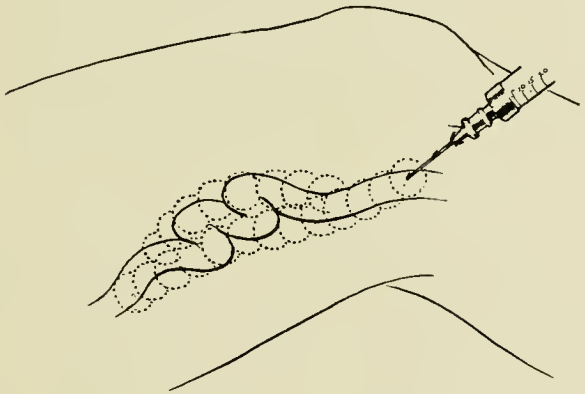


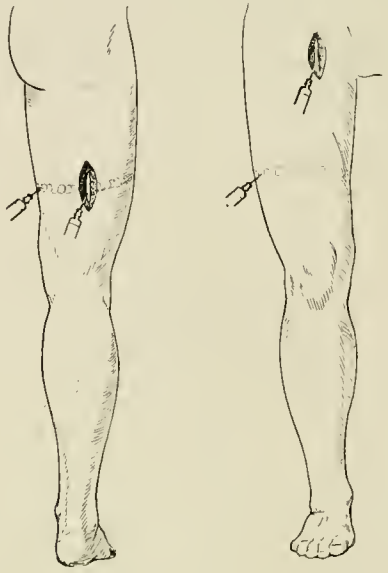
Fig. 102. Infiltration of skin over varicose vein.

and some of the lipomas are the most frequent. The spindle celled sarcomas of the calf and popliteal space and the carcinomas and endotheliomas, though technically removable under local anesthesia, should be reserved for radical operations under general anesthesia.

AMPUTATIONS.—Toes like the fingers may easily be removed under local anesthesia. The technic is the same as that for the fingers.

Major amputations may be done under local anesthesia following the same principles as those given

for the arm. The technic is less complicated since the sciatic nerve (Fig. 103A) is easily accessible and the branches of the anterior crural and obturators may usually be controlled by perineural blocking (Fig. 103B). This operation is best reserved for the



A B

Fig. 103. *A.* Blocking of sciatic nerve. *B.* Blocking of anterior crural nerve.

skilled technician in cases in which general anesthesia is extra-hazardous.

FRACTURES AND DISLOCATIONS.—As in the arm, injection about the extremities of the fractured fragments lessens very materially the pain of manipulation. In dislocation of the hip the injection of several syringe-fulls into the joint cavity is said to much facilitate reduction.

INTRAVENOUS ANESTHESIA.—Recently, Bier has introduced a method which seeks to anesthetize an entire extremity by the injection of the anesthetic solution into the veins. The technic is briefly as follows: An area is made bloodless by means of two constrictors (Fig. 104). Within this anemic area a vein is laid bare after endermic injection and the fluid is injected directly into it. Usually from four drams to an ounce is required. One-half per

Fig. 104. Placing of the constrictors in Bier's venous anesthesia.

cent. novocain is used. Various major operations have been carried out under it. The chief objection to the method seems to be that the method requires considerable technical skill in order to carry it out in a satisfactory manner. The duration of the anesthesia is brief, usually not over fifteen minutes. This may be somewhat increased by the addition of adrenalin. The brevity of the anesthesia makes it unsuited for careful joint work and its use would seem to be restricted to major operations of short duration. I have had no experience with the method.

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